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ABSTRACT

This document contains the final program and abstracts for the 1997 annual meeting of the National Association for Research in Science Teaching (NARST). Strands of the meeting included "Learning: Students' Conceptions and Conceptual Change"; "Learning: Classroom Contexts and Learner Characteristics"; "Teaching"; "Teacher Education"; "Curriculum, Evaluation, and Assessment"; "Cultural, Social, and Gender Issues"; "Educational Technology"; "History, Philosophy, and Epistemology"; and "Informal Learning". This program also contains general information about NARST including NARST Outstanding Paper Award submissions, an explanation of program session formats, the strand key, publishers' exhibits, information about the 1998 NARST annual meeting, strand coordinators, program proposal assessors, award winners, and the names of various committees and representatives. (JRH)

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Final Program and Abstracts

1997 NARST Annual Meeting

Making a Difference:
Building a Coherent Theory of Learning

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1997 NARST Annual Meeting

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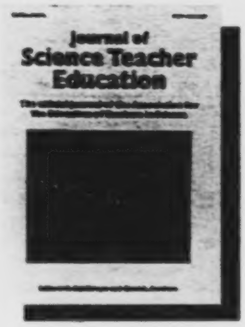

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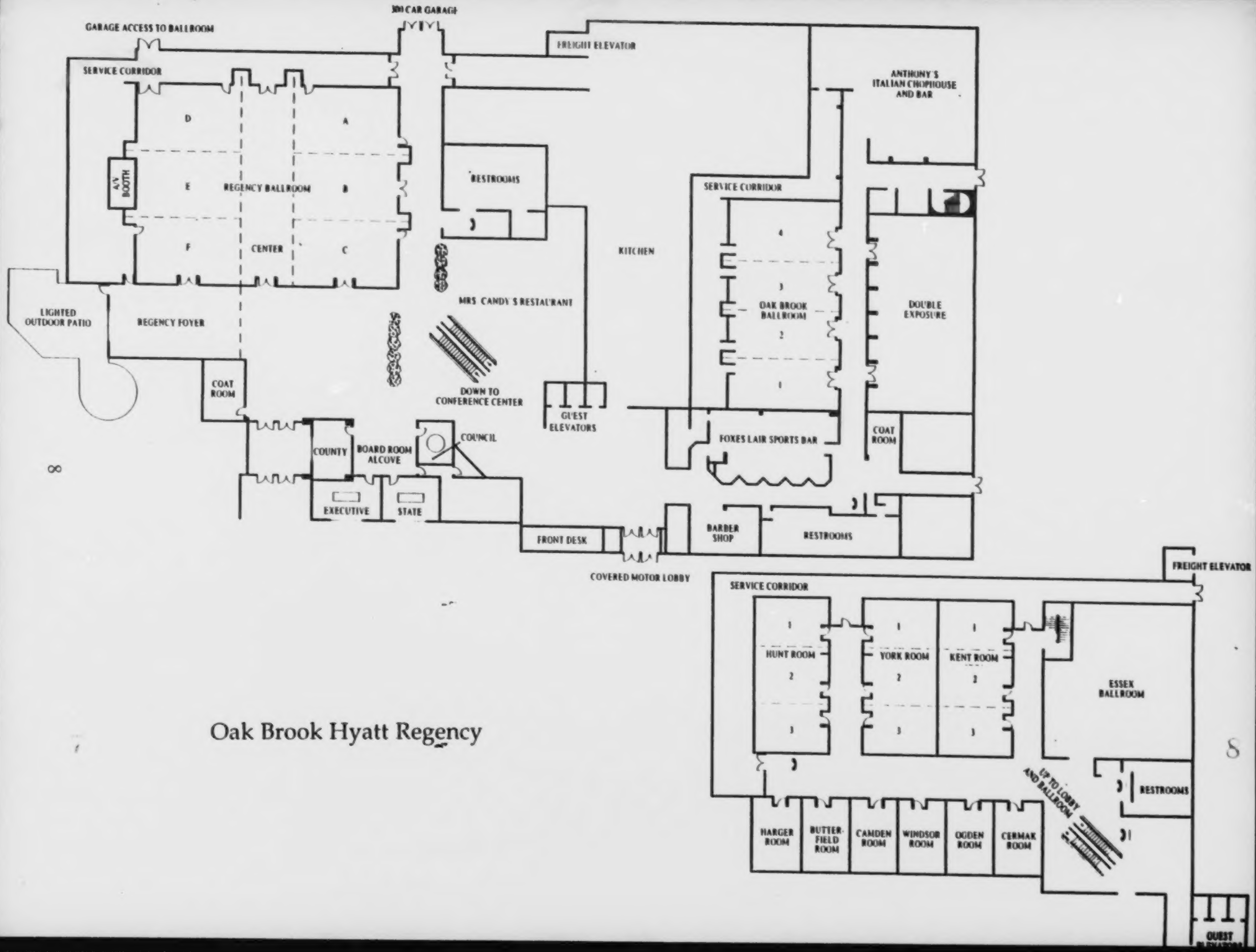
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- Go to designated room early. Arrange room furniture to suit the type of session. Check function of overhead projector and other audiovisual equipment.
- Meet and greet presenters. Check the pronunciations of names and institutional affiliations.
- Agree on the order and time allotments for presentations, questioning and discussion.
- Urge audience to sit near front or to adjust to optimal seating pattern.
- Start session promptly. Also dismiss it on time.
- Hold presenters to the agreed time schedule. Hold up cards marked '3 minutes', '1 minute', 'Time is up!' Stand up if necessary.
- Adjust lights and/or window shades for desired lighting. Leave door open to encourage late arrivals but close it if necessary.
- Adjust overhead projector if not focused or not framed on screen. Turn it off if not in continuous use. Assist with use of other AV equipment.
- Assist presenters in distributing their papers.
- Monitor questions. Keep questions, brief, civil and on the topic. Assure fair involvement.

Symposia

Presentations, discussion and questioning are controlled by the proposer, or a presider/discussant selected by the proposer. Discussion should promote the expression of alternative viewpoints and theoretical positions.

Discussion Groups

Discussion group presentations are quite informal and of short duration. Most of the session time should be devoted to dialogue between presenters and audience.

Round Tables

In round table sessions, each presenter is assigned a table and makes a short, informal presentation followed by discussion which he/she controls.

Acknowledgements

The 1997 NARST Annual Meeting Program and Abstracts book was prepared at San Diego State University, the University of Georgia, and The Ohio State University by the following individuals:

Kathleen Fisher, Program Chair
Patrick Kenney, Program Organizer
Stacy Gomes, Program Organizer
David Jackson, Data Processing
Arthur White, Final Editing and Printing

Skilful assistance was provided by Deborah Escamilla and Stacy Earwicker.

PART A

General Information

Information about NARST

The National Association for Research in Science Teaching was founded in 1928 for the purpose of promoting research in science education at all educational levels and disseminating the findings of this research in such ways as to improve science teaching. The Association is incorporated as a non-profit corporation in the State of Minnesota. The official publication is the *Journal of Research in Science Teaching.*

NARST encourages the conduct and presentation of the results of a wide variety of investigations in all aspects of science education, including action, historical, philosophical, ethnographic, experimental and evaluative studies. Reports of empirical research, critical reviews and theoretical works are encouraged. Some research areas of interest to NARST members include curriculum development and organization, assessment and evaluation, learning theory, teacher education, programs for the talented and handicapped, equity studies and methods of teaching.

Current membership is about 1400, the highest ever. Approximately 20% are non-US, making NARST a truly international organization. Almost 65% have joined since 1990. Approximately 40% of the members attend the annual meetings.

The Association's headquarters are located with the office of the Executive Secretary. Inquiries regarding membership and other matters should be addressed to:

Arthur L. White
Executive Secretary, NARST
1929 Kenny Road, Room 200E
The Ohio State University
Columbus, OH 43210, USA
Telephone: (614) 292-3339
Fax: (614) 292-1595
E-Mail: TS0002@ohstmvsa.acs.ohio-state.edu

How NARST Keeps its Members Informed

- Ten issues of the *Journal of Research in Science Teaching* (JRST). The Journal has been ranked as one of the highest quality educational journals according to studies published by War, Holland and Schramm (*American Educational Research Journal*) and Guba and Clark (*Educational Researcher*) for the American Educational Research Association (AERA). These authors identified JRST as clearly the top research journal in science education.
- Abstracts of research papers presented at the annual meeting.
- Quarterly newsletter describing recent developments in research and in the profession. Opportunities to work with prominent people throughout the world on research projects and with such affiliated organizations as the National Science Teachers Association (NSTA) and the American Association for the Advancement of Science (AAAS).

NARST Outstanding Paper Award Submissions

Presenters wishing to have their papers considered for the 1997 Outstanding Paper Award must place one copy in the box marked "1997 NARST Outstanding Paper Award" located near the registration table at the 1997 Annual Meeting. In late April, the Chairperson will request that the first author send 8 copies of the paper with names and affiliations of all authors removed. Authors have six weeks to send in copies of their paper.

The newly elected Executive Board Member who will serve as Chairperson of the NARST Outstanding Awards Committee will be identified at the meeting.

Explanation of Program Session Formats

SYMPOSIUM: A symposium presents a single important issue, controversial topic or area of research. One or more short presentations are made and summarized by a designated discussant. The discussant promotes and coordinates active debate and discussion among the participants.

PAPER SET: A paper set format consists of 3-5 research reports on the same or similar topic. Some sets are arranged by a proposer; others are grouped by the program committee. While audience discussion is important, most of the session time is devoted to presentations.

DISCUSSION GROUP: A discussion group format is similar to a paper set but the presentations are shorter and more informal. Most of the session time is for dialogue among presenters and participants.

ROUND TABLE: In this format, a single paper is presented informally to a small group seated at a round table or in a circle. The purpose of this format is to promote intimate discussion of the topic by those intensely interested in it.

POSTER: This format is a visual display of text, graphs, charts, photographs, etc. on a poster board with display space of 4 by 4 feet (1.2m by 1.2m). Presenters talk informally with participants who move among the displays.

OTHER: Other formats may include presentations by invited speakers, audiovisual demonstrations, debates, and others of a novel nature.

Strand Key

STRAND 1	Learning: Students' Conceptions and Conceptual Change
STRAND 2	Learning: Classroom Contexts and Learner Characteristics
STRAND 3	Teaching
STRAND 4	Teacher Education
STRAND 5	Curriculum, Evaluation and Assessment
STRAND 6	Cultural, Social and Gender Issues
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Technology/Resources Room **Camden**

Following the success of the Technology/Resources Room at previous conferences, John Wiggins and William Veal of the University of Georgia will coordinate a similar room at the 1997 NARST annual meeting. The Technology/Resources Room will be housed in the Camden Room. The Technology/Resources Room will provide conference participants with facilities for viewing videotapes and examining commercial computer software, as well as a place to meet to discuss issues in educational technology. Limited provisions for copying floppy disks also could be available.

A Special Thanks to Sponsors

John Wiley and Sons, Publishers, for their sponsorship of the JRST Editorial Board Meeting and Dinner. **Kluwer Academic Publishers**, for their sponsorship of the Special Session for Past-Presidents, Executive Secretaries and Recipients of the Distinguished Contributions Through Research Award.

Publishers' Exhibits

At this year's NARST annual meeting, the following eight publishers will exhibit their books in the Lower Lobby:

- *AAAS*
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- *ERIC Clearinghouse for Science, Mathematics, and Environmental Education*
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SUBMISSION DEADLINE:

Program proposals for the 1998 annual meeting must be received by strand coordinators by **August 15, 1997.** The deadline allows sufficient time for processing and evaluating the many proposals. The call for proposals will appear in the March and June issues of *NARST News*.

FURTHER INFORMATION:

John Wiggins, 1998 Program Coordinator
Science Education Department
University of Georgia
Athens, GA 30602
Telephone: (706) 542-1763 Fax: (706) 542-1212
E-mail:JWIG@UGA.CC.UGA.EDU

Future Meeting Dates for NARST, NSTA and AERA

1998	AERA	San Diego	April 14-18
	NSTA	Las Vegas	April 16-19
	NARST	San Diego	April 19-22
1999	NSTA	Boston	March 25-28
	NARST	Boston	March 28-31
	AERA	Montreal	April 19-23
2000	NSTA	Orlando	April 6-9
	AERA	New Orleans	April 24-28
	NARST	Date and Location To Be Announced	

Strand Coordinators

STRAND 1	*Learning: Students' Conceptions and Conceptual Change* Mike Smith, Mercer University School of Medicine Marcia K. Fetters, University of North Carolina
STRAND 2	*Learning: Classroom Contexts and Learner Characteristics* Randy Yerrick and Jon Pedersen, East Carolina University
STRAND 3	*Teaching* Warren Tomkiewicz, Plymouth State College
STRAND 4	*Teacher Education* Charlene Czerniak, University of Toledo; Andrew Lumpe, Southern Illinois University
STRAND 5	*Curriculum, Evaluation, and Assessment* Chin-Tang Liu, University of Iowa Gail Jones, University of North Carolina-Chapel Hill
STRAND 6	*Cultural, Social, and Gender Issues* Josephine M. Shireen Desouza, Ball State University Jerome M. Shaw, Far West Lab
STRAND 7	*Educational Technology* R. Paul Vellom and Michael Beeth, The Ohio State University
STRAND 8	*History, Philosophy, and Epistemology* Cathy Loving, Texas A & M University
STRAND 9	*Informal Learning* Bernadette Peiffer, SCI TREK

Program Proposal Assessors

Program proposals were given blind reviews by a group of assessors which included members of the Program Committee and the following:

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1943	Florence G. Billig
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1945	Florence G. Billig
1946	C. L. Thield
1947	Earl R. Glenn
1948	Ira C. Davis
1949	Joe Young West
1950	N. Eldred Bingham
1951	Betty Lockwood
1952	Betty Lockwood
1953	J. Darrell Barnard
1954	George C. Mallinson
1955	Kenneth E. Anderson
1956	W. C. Van Deventer
1957	Waldo W. Blanchet
1958	Nathan S. Washton
1959	Thomas P. Fraser
1960	Vaden W. Miles
1961	Clarence H. Boeck
1962	Herbert A. Smith
1963	Ellsworth S. Obourn
1964	Cyrus W. Barnes
1965	Frederic B. Dutton
1966	Milton P. Pella
1967	H. Craig Sipe
1968	John M. Mason
1969	Joseph D. Novak
1970	Willard D. Jacobson
1971	Paul D. Hurd
1972	Frank X. Sutman
1973	J. David Lockard
1974	Wayne W. Welch
1975	Robert E. Yager
1976	Ronald D. Anderson
1977	O. Roger Anderson
1978	Roger G. Olstad
1979	James R. Okey
1980	John W. Renner
1981	Stanley L. Helgeson
1982	Stanley L. Helgeson
1983	Carl F. Berger
1984	Ann C. Howe
1985	Ertle Thompson
1986	David P. Butts
1987	James P. Barufaldi
1988	Linda DeTure
1989	Patricia Blosser
1990	William G. Holliday
1991	Jane Butler Kahle
1992	Russell H. Yeany
1993	Emmett L. Wright
1994	Kenneth G. Tobin
1995	Dorothy L. Gabel
1996	Barry J. Fraser
1997	Thomas R. Koballa, Jr.

Emeritus Members

Michael L. Agin
Andrew Ahlgren
Norman D. Anderson
Glenn D. Berkheimer
Paul Black
Napoleon Bryant, Jr.
David P. Butts
Kim Dong Chan
Kevin F. Collis
Abraham Fischler
Ronald M. Frinks
Richard E. Haney
Robert W. Howe
Jehuda Huppert
Paul DeHart Hurd
Gordon P. Johnson
Paul H. Joslin
Ehud Jungwirth
J. David Lockhard
Jacqueline Mallinson
Victor J. Mayer
Dale G. Merkle
Gene W. Moser
Joseph D. Novak
Roger G. Olstad
Seoung Hey Paik
Mary Ellen Quinn
John C. Rosemergy
Dorothy B. Rosenthal
John F. Schaff
Robert L. Shrigley
H. Craig Sipe
Frank X. Sutman
Joyce Swartney
Henry J. Triezenberg
Burton E. Voss
Wayne W. Welch

NARST Award Winners

Distinguished Contributions to Science Education Through Research Award

This award is given at the annual meeting but is bestowed only when a superior candidate is identified. It is given to recognize an individual who, through research over an extended period of time, has made outstanding and continuing contributions, provided notable leadership, and made a substantial impact in the area of science education.

Year	Awardee
1986	Anton E. Lawson
1987	Paul DeHart Hurd
1988	John W. Renner
1989	Willard Jacobson
1990	Joseph D. Novak
1991	Robert L. Shrigley
1992	Pinchas Tamir
1993	Jack Easley, Jr.
1994	Marcia C. Linn
1995	Wayne W. Welch
1996	Carl F. Berger

JRST Award

The JRST Award is given annually for the article published in the *Journal of Research in Science Teaching* during the previous year and judged to be the most significant for that year.

Year	Awardee
1974	Donald E. Riechard and Robert C. Olson
1975	Mary Budd Rowe
1976	Marcia C. Linn and Herbert C. Thier
1977	Anton E. Lawson and Warren T. Wollman
1978	Dorothy Gabel and J. Dudley Herron
1979	Janice K. Johnson and Ann C. Howe
1980	John R. Staver and Dorothy Gabel
(tie)	Linda R. DeTure
1981	William C. Kyle, Jr.
1982	Robert G. Good and Harold J. Fletcher
(tie)	F. David Boulanger
1983	Jack A. Easley, Jr.
1984	Marcia C. Linn, Cathy Clement and Stephen Pulos
1985	Julie P. Sanford
1986	Anton E. Lawson
1987	Russell H. Yeany, Kueh Chin Yap and Michael J. Padilla
1988	Kenneth G. Tobin and James J. Gallagher
(tie)	Robert D. Sherwood, Charles K. Kinzer, John D. Bransford and Jeffrey J. Franks
1989	Anton E. Lawson
1990	Richard A. Duschl and Emmett L. Wright
1991	E. P. Hart and I. M. Robottom
1992	John R. Baird, Peter J. Fensham, Richard E. Gunstone and Richard T. White
1993	Nancy R. Romance and Michael R. Vitale
1994	E. David Wong
1995	Stephen P. Norris and Linda M. Phillips
1996	David F. Jackson, Elizabeth C. Doster, Lee Meadows and Teresa Wood

Outstanding Paper Award

The Outstanding Paper Award is given annually for the paper or research report presented at the annual meeting that is judged to have the greatest significance and potential in the field of science education.

Year	Awardee
1975	John J. Koran
1976	Anton E. Lawson
1977	no award
1978	Rita Peterson
1979	Linda R. DeTure
1980	M. James Kozlow and Arthur L. White
1981	William Capie, Kenneth G. Tobin and Margaret Boswell
1982	F. Gerald Dillashaw and James R. Okey
1983	William C. Kyle, Jr., James A. Shymansky and Jennifer Alport
1984	Darrell L. Fisher and Barry J. Fraser
1985	Hanna J. Arzi, Ruth Ben-Zvi and Uri Ganiel
(tie)	Russell H. Yeany, Kueh Chin Yap and Michael J. Padilla
1986	Barry J. Fraser, Herbert J. Walberg and Wayne W. Welch
1987	Robert D. Sherwood
1988	Barry J. Fraser and Kenneth G. Tobin
1989	James J. Gallagher and Armando Contreras
1990	Patricia L. Hauslein, Ronald G. Good and Catherine Cummins
1991	Nancy R. Romance and Michael Vitale
1992	Patricia Heller, Ronald Keith and Scott Anderson
1993	Wolff-Michael Roth
1994	Wolff-Michael Roth and Michael Bowen
1995	Wolff-Michael Roth
1996	Nancy J. Allen

Outstanding Doctoral Dissertation Award

This award was established in 1992 to be given annually for the doctoral dissertation judged to have the greatest significance in the field of science education.

Year	Awardee	Major Professor
1992	René Stofflett	Dale R. Baker
1993	Julie Gess-Newsome	Norman G. Lederman
1994	Carolyn W. Keys	Burton E. Voss
1995	Jerome M. Shaw	Edward Haertel
1996	Christine M. Cunningham	William L. Carlsen

Outstanding Master's Thesis Award

This award was established in 1995 to be given annually for the master's thesis judged to have the greatest significance in the field of science education.

Year	Awardee	Major Professor
1995	Moreen K. Travis	Carol L. Stuessy
1996	Lawrence T. Escalada	Dean A. Zollman

Early Career Research Award

The Early Career Research Award is given annually to the early researcher (the recipient will have received his/her doctoral degree within five years of receiving the award) who demonstrates the greatest potential to make outstanding and continuing contributions to educational research.

Year	Awardee	Year	Awardee
1993	Wolff-Michael Roth	1995	Nancy B. Songer
1994	Deborah J. Tippins	1996	Mary B. Nakhleh

Classroom Applications Award

The Classroom Applications Award was established in 1979. The award was given annually to authors whose papers were presented at the previous annual meeting and judged to be outstanding in terms of emphasizing classroom application of research in science education. The award was last presented in 1991.

Year	Awardee
1980	Livingston S. Schneider and John W. Renner
Five Equal Awards	Heidi Kass and Allan Griffiths
	Ramona Saunders and Russell H. Yeany
	Joe Long, James R. Okey and Russell H. Yeany
	M. James Kozlow and Arthur L. White
1981	Dorothy Gabel, Robert D. Sherwood and Larry G. Enochs
Four Equal Awards	Wayne Welch, Ronald D. Anderson and Harold Pratt
	Mary Ellen Quinn and Carolyn Kessler
	P. Ann Miller and Russell H. Yeany
1982	Louise L. Gann and Seymour Fowler
Four Equal Awards	Dorothy L. Gabel and Robert D. Sherwood
	Thomas L. Russell
	Joseph C. Cotham
1983	Robert D. Sherwood, Larry G. Enochs and Dorothy Gabel
1984	Mary Westerback, Clemencia Gonzales and Louis H. Primavera
Four Equal Awards	Kenneth G. Tobin
	Hanna J. Arzi, Ruth Ben-Zvi and Uri Ganiel
	Charles Porter and Russell H. Yeany
1985	Dan L. McKenzie and Michael J. Padilla
Three Equal Awards	Margaret Walkosz and Russell H. Yeany
	Kevin C. Wise and James R. Okey
1986	Sarath Chandran, David F. Treagust and Kenneth G. Tobin
Four Equal Awards	Darrell L. Fisher and Barry J. Fraser
	Dorothy L. Gabel, Stanley L. Helgeson, Joseph D. Novak, John Butzow and V. K. Samuel
	Linda Cronin, Meghan Tweist and Michael J. Padilla
1987	Dorothy L. Gabel, V. K. Samuel, Stanley L. Helgeson, Saundra McGuire, Joseph D. Novak and John Butzow
1988	Uri Zoller and Benn Chaim
1989	James D. Ellis and Paul J. Kuerbis
1990	Dale R. Baker, Michael D. Piburn and Dale S. Niederhauser
1991	David F. Jackson, Billie Jean Edwards and Carl F. Berger

NARST Committees and Representatives 1996–1997

Election Committee

Chair:

Barry Fraser '97	Curtin University, Australia

Members:

Cheryl Mason '97	San Deigo State University
William Coburn '97	Arizona State University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Policy Advisory Committee

Chair:

Barry Fraser '97	Curtin University

Members:

Vincent Lunetta	Pennsylvania State University
Rita Perterson	University of California - Irvine
Thomas Koballa, Jr. (ex-officio)	University of Georgia
Audrey Champagne (ex-officio)	University at Albany

Financial Advisory Committee

Chair:

James Ellis '99	National Science Foundation

Members

Rodney Dornan '98	University at Buffalo
John Penick '99	University of Iowa
Julie Gess-Newsome '97	University of Utah
Thomas Koballa, Jr. (ex-officio)	University of Georgia
Arthur White (ex-officio)	Ohio State University

Research Committee

Chair:

Robert Sherwood '98	Vanderbilt University

Members:

Norman G. Lederman '97	Oregon State University
Maureen McMahon '98	University of Maryland
Patricia Simmons '98	University of Georgia
Thomas Koballa, Jr. (ex-officio)	University of Georgia
Arthur White (ex-officio)	Ohio State University

Publications Advisory Committee

Chair:

Kathleen J. Roth '97	Michigan State University

Members:

Cathleen Loving '99	Texas A&M
Bonnie Shapiro '98	University of Calgary
Edmond Merek '97	University of Okalahoma
William C. Kyle, Jr. (ex-officio)	U. of Missouri - St. L.
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Program Committee

Chair:

Audrey Champagne	University at Albany - SUNY

Members:

Gerald Abegg	Boston University
Charlene Czerniak	University of Toledo
Mary Ann Davison	Interamericana University, P. R.
Lynn Dierking	Science Learning Inc.
Rodney Doran	University at Buffalo
Kathleen Fisher	San Diego State University
Jenice French	Kansas State University
Alejandro Gallard	Florida State University
Paul Germann	University of Missouri
Mert Glass	Cumberland College
Peter Hewson	University of Wisconsin
William Holliday	University of Maryland
Gail Jones	University of North Carolina
Pat Keig	California State University, Fullerton
Chin-Tan Liu	University of Iowa
Cathy Loving	Texas A&M University
Andrew Lumpe	University of Toledo
Romon Meta-Toledo	James Madison University
Maureen McMahon	University of Maryland
Hedy Moscovici	Western Washington University
Karen Ostlund	Southwest Texas State University
Bernadette Peiffer	SCI TREK
Eric Pyle	West Virginia University
Anita Roychoudhury	Miami University (Ohio)
Kate Scantlebury	University of Delaware
John Settlage	Cleveland State University
Robert Sherwood	Vanderbilt University
Linda Shore	Exploratorium Teacher Institute
Jim Shymansky	University of Iowa
Nancy Songer	University of Colorado
Sue Stocklmayer	Curtin University, Australia
David Tallant	Emory University
Deborah Tippins	University of Georgia
Bruce Waldrip	Curtin University, Australia
Melissa Warden	Ball State University
Theo Wubbels	University of Utrecht, Netherlands
Jong-Hsiang Yang	National Taiwan Normal University
Randy Yerrick	East Carolina University
Larry Yore	University of Victoria
Barry J. Fraser (ex-officio)	Curtin University, Australia
John Staver (ex-officio)	Kansas State University

International Committee

Chair:

Peter W. Hewson '97	University of Wisconsin

Members:

Hanna Azri '97	King's College London, UK
Deyanira Barnett '99	Universidad de Panama
Justin Dillon '97	King's College London, UK
Hans Niedderrer '99	University of Bremen, Germany
John Wallace '97	Curtin University, Australia
Katherine Wieseman '98	University of Georgia
Theo Wubbels '97	Univ. of Utrecht, The Netherlands
Shu-Mey Yu '99	National Taichung Teachers College
Aletta Zietsman '98	University of Witwatersrand, S. A.
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Representative to the International Council of Associations for Science Education (ICASE)

Peter W. Hewson '97	University of Wisconsin

Representatives to the American Association for the Advancement of Science

Section Q (Education)

Jane Butler Kahle '97	Miami University (Ohio)

Section X (Societal Impact on Science and Engineering)

Marcia C. Linn '97	University of California, Berkeley

Distinguished Contributions to Science Education Through Research Award Committee

Chair:

David F. Treagust '98	Curtin University, Australia

Members:

Marianne Barnes '99	University of Florida
Reinders Duit '99	University of Kiel
Jane Butler Kahle '97	Miami University, Ohio
Alan J. McCormack '97	San Diego State University
Joseph Novak '98	Cornell University
Larry Yore '98	University of Victoria
Thomas Koballa, Jr. (ex-officio)	University of Georgia
Arthur L. White (ex-officio)	The Ohio State University

JRST Award Committee

Chair:

Nancy Brickhouse '98	University of Delaware

Members:

Gerald Abegg '98	Boston University
Michael R. Abraham, '99	University of Oklahoma
Donna Berlin '98	The Ohio State University
William J. Boone, '98	Indiana University
Carol Briscoe, '98	University of West Florida
Julia Clark, '98	National Science Foundation
Liza Finkel '98	University of Michigan
April Gardner, '99	University of Northern Colorado
Jenifer Helms '97	University of Colorado
Paul Hobden '97	University of Natal, South Africa
Okhee Lee '98	University of Miami
Sherry Nichols, '99	University of Texas
William Robins '98	University of Miami
J. Leonardo Sanchez '97	Indiana University
M. Gail Shroyer '97	Kansas State University
James Shymansky '98	University of Iowa
Mike U. Smith '99	Mercer Univ. School of Medicine
Peter Taylor '98	Curtin University, Australia
Debra J. Tomanck '97	North Dakota State University
Jan van den Akker '99	Univ. of Twente, Netherlands
Emily van Zee, '99	University of Maryland
Richard L. Williams, 99	University of Victoria

Outstanding Paper Award Committee

Chair:

Pat Keig '99	California State University - Fullerton

Members:

Laura Barden '97	Western Illinois University
Tom Dana "99	Pennsylvania State University
Rebecca Denning '98	The Ohio State University
Yehudit Dori '97	Technion - Israel Inst. of Technology
Avi Hofstein '98	Weizmann Institute of Science, Israel
Judith Johnston '99	University of Central Florida
Doris Jorde '98	University of Oslo, Norway
Eileen Lewis '97	U. of California, Berkeley
Shirley J. Magnusson '97	University of Michigan
Diana Mason '99	University of Texas, Austin
Sheron Nichols '98	University of Texas, Austin
Leslie Parker '98	Curtin University, Australia
Eileen Parsons '99	Lenoir Rhyne College
Iris M. Riggs '97	California State U. - San Bernadino
Nancy B. Songer '97	University of Colorado
Mary Stein '97	Wayne State University
Michael Svec '99	Rockhurst College
Julie Thomas '98	University of Nebraska - Lincoln
William Yarroch '99	Michigan Technology University
Janell Wilson '99	Livingston University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Outstanding Doctoral Dissertation Award Committee

Chair:

Anita Roychoudhury '99	Miami University

Members:

Elizabeth Charron '97	Montana State University
Darrell Fisher '98	Curtin University, Australia
Mansoor Niaz '98	University of Oriente, Venezuela

Carolyn Keys '99	Georgia State University
J. Steve Oliver '97	University of Georgia
Kathleen O'Sullivan '97	San Francisco State University
Nancy Romance '97	Florida Atlantic University
Julie Thomas '99	University of Nebraska-Linclon
Josephine Wallace '99	University of North Carolina
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Outstanding Master's Thesis Award Committee

Chair:

James D Ellis '99	National Science Foundation

Members:

Walter Bisard '99	Central Michigan State
Michael Bowen '98	University of Guelph
Jenice French '97	Kansas State University
Mark Guy '99	University of North Dakota
Gail Jones '97	University of North Carolina
Reuven Lazarowitz '98	Technion-Israel Inst. of Tech.
David Martin '99	Kennesaw State University
John Sode '97	North Dakota State University
Warren Tomkiewicz '98	Plymouth State College
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Early Career Research Award Committee

Chair:

Robert Sherwood '98	Vanderbilt University

Members:

Charles W. Anderson '97	Michigan State University
Frank E. Crawley '97	East Carolina University
Campbell McRobbie '98	Queensland Univ., Australia
Mary B. Nakhleh '99	Purdue University
Joseph P. Riley '99	University of Georgia
Wayne Welch '98	University of Minnesota
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Equity Committee

Chairs:

Sandra Abell '98	Purdue University

Members:

Josephine DeSouza '99	Ball State University
Larry Flick, '99	Oregon State University
Anne Howe '97	University of Maryland
Sharon Lynch '98	George Washington University
Randy McGinnis '98	University of Maryland
Claudia Melear '97	East Carolina University
Leonie Rennie '97	Curtin University, Australia
Jerome Shaw '98	Far West Laboratory
Molly Weinburgh, '99	Georgia State University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

New Generation of Researchers Committee

Co-Chairs:

Maureen M. McMahon	University of Maryland
Cristine Kelly	University of Maryland

Members:

Thomas Andre	Iowa State
Brenda Evans	N. Carolina Dept. of Public Instruction
Sharon Haggerty	University of Western Ontario
Vasilios Svolopoulos	Fordham university
Kathleen Blouch	Temple University
Jazlin Ebenezer	University of Manitoba
Roy Hurst	University of Southern Mississippi
Julia McArthur	Bowling Green State University
Richard Pontius	SUNY Plattsburgh
William Priestley	Temple University
Holly Priestley	Temple University
John Tillotson	University of Iowa
William Veal	University of Georgia
Scott Slough	Sam Houston State University
Nicole Holthuis	Stanford University
Susan Koba	Omaha Public Schools
Julie Schmidt	University of Delaware
Elizabeth Doster	East Carolina University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Committee for Indivudual Networking

Co-Chairs:

Katherine I. Norman	University of Texas, Brownsville
B. Patricia Patterson	Wesley College, Delaware

Members:

Jerry Foster	De Paul University
Meta van Sickle	Univ. of Charleston
Patricia Schroeder	Johnson County Comm. College
Shelia Jasalavich	Marist College
J. Preston Prather	University of Virginia
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Liaison with Scientific Societies Committee

Co-Chairs:

Susan Speece	Anderson University
Diane Ebert-May	Northern Arizona University

Members:

Allan Feldman	University of Massachusetts
Loretta L. Jones	University of Northern Colorado
Jim Minstrell	ACT Systems for Education
Nir Orion	Weizmann Institute of Science, Israel
Eric Pyle	West Virginia University

NARST Presentations at Other Professional Meetings Committee

Chair:

Barry J. Fraser '97	Curtin University, Australia

Members:

Ellen Bunderson	Brigham Young University
Kathie Black	University of Victoria
Lloyd Barrow	University of Missouri
Douglas Huffman	University of Minnesota
Deidra Young	Curtin University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

NARST Political Action Committee

Chair:

Michael Klapper	The Ohio State University

Members:

Roger Bybee	National Research Council
Frank Sutman	Temple University
Ann Howe	University of Maryland
Paul Joslin	Drake University
Emmett Wright	Kansas State University
John Staver	Kansas State University
Arthur White	The Ohio State University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

Committee on Recruiting and Retaining Members

Chair:

Sandra Abell '98	Purdue University

Members:

Kenneth Tobin '97	Florida State University
Dale R. Baker '98	Arizona State University
Geoff Giddings '99	Curtin Univ. of Technology

NARST-net Committee

Chair:

Derrick Lavoie	Black Hills State University

Members:

Bill Baird	Auburn University
Murray Jensen	University of Minnesota
Amanda Woods McConney	Western Oregon St. College
Joseph Peters	University of West Florida
Mark Turski	Plymouth State College
Arthur L. White	The Ohio State University
Thomas Koballa, Jr. (ex-officio)	University of Georgia

PART B

Annual Meeting Program

8:00am-8:00pm **Friday, March 21, 1997**

Registration **Lobby**

8:00am-4:00pm **Meeting** **Friday, March 21, 1997**

NARST Executive Board Meeting #1 **Ogden**

9:30am-12:00pm **Preconference Workshop** **Friday, March 21, 1997**

Pre-Session Workshop #1: **Butterfield**
The Measurement and Analysis of Change in the Learning of Science

Presenters:
John Keeves, *Flinders University of South Australia*; Trevor Johnson, *Australian Council for Educational Research*; Paul Williamson, *Flinders University of South Australia*

10:00am-3:30pm **Preconference Tours** **Friday, March 21, 1997**

Pre-Conference Tour #1: Art Institute of Chicago

Pre-Conference Tour #2: Lakefront Museums

1:00pm-3:30pm **Preconference Workshop** **Friday, March 21, 1997**

Pre-Session Workshop #2: **Windsor**
Reading to Learn and Writing to Learn Science

Presenters:
Larry Yore, *University of Victoria*; James Shymansky, *University of Iowa*; Science PALs Staff, *University of Iowa, Iowa City Community Schools*

4:00pm-5:30pm **General Session** **Friday, March 21, 1997**

1.01 **Regency Ballroom**
Science Achievement and the Curriculum: A Report from the Third International Mathematics and Science Study

Presenter:
William H. Schmidt, *Michigan State University*

6:00pm-7:00pm **Orientation Session** **Friday, March 21, 1997**

2.01 **Spring Room**
New Generation of Researchers' Orientation (including international members)
(Discussion Group)
Presider: William Holliday, *University of Maryland*

6:00pm-7:00pm **Reception** **Friday, March 21, 1997**

Reception for International Presenters **Essex**

7:00pm-8:30pm Invited Session Friday, March 21, 1997

3.01 **Harger**

Discussion with William Schmidt

(Discussion Group)

Presenter:

William H. Schmidt, *Michigan State University*

7:00pm-8:30pm Strand Sessions Friday, March 21, 1997

3.02 **Butterfield**

Constructivism in Teacher Education

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Jodi Haney, *Bowling Green State University*

BICOMP Science: A Sheltered Constructivist Model of School Change

Lorie Hammond, *Washington Unified School District*; Barbara Merino, *University of California, Davis*

The Impact of Coursework in Constructivistic Inquiry on Pre-Service Elementary Teachers' Choices of Instructional Strategies

Michael P. Marlow, *University of Colorado at Denver*

Impact of Course and Program Design Features on the Preparation of Preservice Elementary Science Teachers

James J. Watters, Ian S. Ginns, *Queensland University of Technology, Australia*

An Interpretive Study of Social Forces that Constrain Actions and Interactions in a Science Classroom in Colombia

Lilia Reyes-Herrera, *Florida State University - Universidad Pedagogica Nacional, Colombia*

3.03 **Windsor**

Social Issues In Science Education

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Diana Mason, *University of Texas at San Antonio*

Gateway to Success for At-Risk Students in a Large-group Introductory Chemistry Class

Diana Mason, *University of Texas at San Antonio*

The Relationship between Attitudes and Classrooms Variables in Single-sex and Mixed-sex Science Classes

Léonie J. Rennie, Lesley H. Parker, *Curtin University of Technology, Australia*

Knowledge and Incidence of Domestic Violence Among Elementary Science Methods Students

Claudia T. Melear, *University of Tennessee*

Undergraduate Minority Students Studying Science: Are You "Acting White" if You're Academically Successful?

Deidre B. Sessoms, *University of California - Davis*

Strategies for Counter-resistance: Helping Preservice Teachers Teach Science for Understanding and for Social Justice

Alberto J. Rodriguez, *University of Wisconsin-Madison*

7:00pm-8:30pm **Strand Sessions** **Friday, March 21, 1997**

3.04 **Cermak**

Gaining Access to Powerful Ideas Through Cooperative Learning

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Laura Barden, *Western Illinois University*

Putting the ME in Group MEmbership: Negotiating Access into a Community of High School Scientists

Catherine Chen, *UC Santa Barbara*

Uchenna and Juwan: New Member Entry into an Elementary Science Discourse Community

Lori A. Kurth, Edward L. Smith, *Michigan State University*

Student Perspectives of Cooperative Learning Activities

Marcy Hamby Towns, Kelly Kreke, *Ball State University*

The Effects of Cooperative Learning in a Second Semester University Computer Science Course

Roger Priebe, *University of Texas, Austin*

3.05 **Hunt 1,2,3**

Expert Science Teaching: Novice Through Expert

(3 Teaching: Symposium)

Presider/Discussant: Senta Raisen, *The National Center for the Improvement of Science*

Using ESTEEM, How Long Does It Take to Become an Expert Constructivist Science Teacher?

Judith A. Burry-Stock, *University of Alabama*; Robert Yager, Gary Varrella, *University of Iowa*

Expertise in Preservice Science Education: An Innovative Approach to Training Elementary Science Educators

Emmett Wright, Gail Shroyer, *Kansas State University*

Expertise in Preservice Science Teaching Across 10 National Sites: The Salish Project

Judy Vopava, *University of Iowa*

Expertise in Inservice Science Education: Relationship Between Science Teachers' Beliefs and Practice

Gary Varrella, *University of Iowa*

On Becoming a Constructivist Biology Teacher

Rosalina Hairston, *University of Southern Mississippi*

Novice Constructivist Middle School Teachers

Jane Konrad, *University of Pittsburgh*

3.06 **Kent 1,2,3**

Issues in Teaching Science in Technologically Rich Environments

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: Michael E. Beeth, *Ohio State University*

Teaching Technology, Teaching Science

Fernando Cajas, *Michigan State University*

Reconciling the Theory of a Constructivist Computer-based Learning Environment with the Constraints of Personal Computers

George Bodner, *Purdue University*; Dorit Maor, *Curtin University*

A Constructivist Approach to Staff Development

Robert James, Caroline Beller, *Texas A&M University*

Technology Enhanced Instruction: A Successful Model for Science Education

Janice Woodrow, Jolie Mayer-Smith, *University of British Columbia*; Erminia Pedretti, *OISE/University of Toronto*

Project INSITE: Training Teacher for Technology Integration in Project Based Science

James D. Lehman, Susan Mandell, *Purdue University*; Michael Rush, Margaret Buchanan, *Eagle-Union Schools*

3.07 **Oak Brook II**

Students Conceptions on Genetechnology and Consequences for Teaching

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Organized by Proposer)

Presider/Discussant: James H. Wandersee, *Louisiana State University*

Teaching Genetechnology Starting from Students' Conceptions - an Introduction

Ute Harms, Corinna Gebhardt, Angela Kroß, *Institute for Science Education, Kiel, Germany*

Students' preconceptions of Bacteria and the Consequences

Horst Bayrhuber, Sabine Stolte, *Institute for Science Education, Kiel, Germany*

Students' conceptions of Genetechnology and Consequences for Moral Development

Corinna Gebhardt, Horst Bayrhuber, *Institute for Science Education, Kiel, Germany*

Connecting Research and Classroom Teaching Regarding the Subject of Genetechnology: presentation of two examples

Angela Kroß, Ute Harms, *Institute for Science Education, Kiel, Germany*

3.08 **Oak Brook III**

Learning Science: An International Perspective

(2 Learning: Classroom Contexts and Learner Characteristics: Symposium)

Presider/Discussant: David F. Treagust, *Curtin University of Technology, Australia*

Learning Science: An International Perspective

David F. Treagust, *Curtin University of Technology, Australia*; Reinders Duit, *University of Kiel, Germany*; John Gilbert, Carol Boulter, *University or Reading, UK*; William Cobern, *University of Western Michigan*; Glen Aikenhead, *University of Saskatchewan*; Phil Scott, Rosalind Driver, *University of Leeds, UK*

3.09 **Oak Brook IV**

Teacher Professional Development

(4 Teacher Education: Discussion Group)

District-wide Professional Development of Science Teachers: Factors Influencing the Implementation of the Chautauqua Model

Pradeep Maxwell Dass, *University of Iowa*

Moving from "Teachers should ..." to "I will ....": Making the Transition from Student to Teacher

Marcia K. Fetters, *University of North Carolina at Charlotte*

Evolving from Teacher to Teacher Leader: The Challenge for Change

Harriett Stubbs, Ann Howe, *North Carolina State University*

Inservicing Science and Mathematics Teachers: A Model that Works!

Patricia Morrell, *University of Portland*; David Curry, *Linn/Benton/Lincoln ESD, Albany, OR*

7:00pm-8:30pm Strand Sessions Friday, March 21, 1997

3.10 **Ogden**

Development and Validation of Instruments for a Cross-National Study of Learning Environments in Australia and Taiwan

(5 Curriculum, Evaluation and Assessment: Paper Set Organized by Proposer)

Presider/Discussant: Jong-Hsiang Yang, *National Taiwan Normal University*

The Development of a Questionnaire for Assessing Student Perceptions of Classroom Climate in Taiwan and Australia

Tai-Chu Iris Huang, *National Kaoshiung Normal University, Taiwan*; Barry J. Fraser, *Curtin University of Technology, Australia*

The Development of a Questionnaire for Assessing Student Perception of Teacher Behaviors in Taiwan and Australia

Hsiao-Ching She, *National Chiao-Tung University, Taiwan*; Darrell L. Fisher, *Curtin University of Technology, Australia*

The Development of a Questionnaire for Assessing Student Perception of Teacher Knowledge in Taiwan and Australia

Hsiao-Lin Tuan, Huey-Por Chang, Kuo-Hua Wang, *National Changhua University of Education, Taiwan*; David F. Treagust, *Curtin University of Technology, Australia*

The Development of a Questionnaire for Assessing Teachers' Beliefs about Science and Science Teaching in Taiwan and Australia

Chung-Chih Chen, *National Kaoshiung Normal University, Taiwan*; Peter C. Taylor, Jill M. Aldridge, *Curtin University of Technology, Australia*

3.11 **York 1,2,3**

Examination of a Teacher Enhancement Institute

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Russell H. Yeany, *University of Georgia*

Goals, Objectives, Activities, and Participants: An Umbrella for Research and Evaluation with Teachers

David P. Butts, J. Steve Oliver, Wyatt W. Anderson, *University of Georgia*

How Teachers Change During an Institute: Quantitative Evaluation and Research Agenda

J. Steve Oliver, Denise K. Crockett, Thomas Elliott, David P. Butts, *University of Georgia*

Middle School Science Teachers' Reflections on Long-Term Participation in a 3-year Institute

Renna B. Calvert, Thomas Elliott, Patricia Schlegel, Denise K. Crockett, J. Steve Oliver, *University of Georgia*

In Their Own Words: Teacher's adoption and use of an instructional innovation

Denise K. Crockett, J. Steve Oliver, Renna B. Calvert, *University of Georgia*

8:00pm-8:30pm Orientation Session Friday, March 21, 1997

3.12 **Oak Brook I**

Mentor/Mentee Program Introduction Session

Presider: Sandra Abell, *Purdue University*

8:30pm-10:00pm Reception Friday, March 21, 1997

General Reception for NARST Members

Regency Ballroom

Presider: Thomas R. Koballa, Jr., *University of Georgia*

8:30pm-10:00pm Strand Sessions Friday, March 21, 1997

4.01 **Spring Room**

Poster Session

(4 Teacher Education: Poster Session)

Preparation for Teaching Science in a Professional Development School: Does Extended Field Experience Make a Difference?
Diane Sopko Adoue, *Texas A & M University*

Factors Influencing Teachers' Likelihood of Innovation Implementation: A Path Analysis
Laura Henriques, *University of Iowa*

Framework for a Japan/United States Collaborative Research Project on Science Teacher Education
Joseph P. Riley, II, Michael J. Padilla, *University of Georgia*; Hideo Ikeda, *Hiroshima University, Japan*

Case Studies of Empowerment and Development: Preservice Elementary Teachers Talk About Science and Science Teaching
Jenice French, Laura Downey, *Kansas State University*

Development of a Framework for the Evaluation of Children's Literature in the Teaching of Science
Scott Slough, Robin McGrew-Zoubi, Jeannine St. Pierre-Hirtle, *Sam Houston State University*

Teaching Abilities of Taiwan Elementary School Teachers on Natural Science
I-shin Chen, *Taipei Municipal Teachers' College*

(7 Educational Technology: Poster Session)

Using Interactive Video Conferencing as a Means to Facilitate Project-Based Learning
Jonathan Singer, Zachary March, James Laffey, *University of Missouri*

Computer Based Learning in Science: What Have Eight Years of Research Shown? An Analysis of Sixty Research Papers
Herman G. Weller, *University of Maine*

The "Scientists in Action Project": Field Studies and Internet Development Activities
Robert D. Sherwood, The Cognition and Technology Group, *Vanderbilt University*

Science Programs on Television: Issues of Authenticity and Inclusiveness
Danielle Joan Ford, *University of Michigan*

Cognitive Styles and Preferences for Computer Assisted Learning in a Self-Paced Second Chance Environment
Colin Trevor Collister, *Storefront School (Broadmead)*; Pierce Farragher, *University of Victoria*

7:00am-8:00am Meetings Saturday, March 22, 1997

Equity Committee	**Hunt 1**
Outstanding Doctoral Dissertation Committee	**Hunt 2**
Outstanding Paper Award Committee	**Hunt 3**
***JRST* Award Committee**	**Kent 1**
Distinguished Contributions to Science Education Through Research Award Committee	**Kent 2**
Early Career Award Committee	**Kent 3**
Outstanding Master's Thesis Award Committee	**York 1**
Policy Advisory Committee	**York 2**

8:30am-10:00am General Session Saturday, March 22, 1997

5.01 **Regency Ballroom**

Implications of the Cognitive and Computer Sciences for Science Learning and Teaching

Presenter:
Roy Pea, *SRI International*

10:30am-12:00pm Invited Session Saturday, March 22, 1997

6.01 **Oak Brook II**

Discussion with Roy Pea

(Discussion Group)

Presenter:

Roy Pea, *SRI International*

10:30am-12:00pm Strand Sessions Saturday, March 22, 1997

6.02 **Butterfield**

Student and Teacher Conceptions of Science

(8 History, Philosophy and Epistemology: Paper Set Grouped by Committee)

Presider/Discussant: Marcia Fetters, *University of Toledo*

The Nature of Science and Instructional Practice: Making the Unnatural Natural

Fouad Abd-El-Khalick, Randy Bell, Norman G. Lederman, *Oregon State University*

College Student's Generic and Specific Conceptions of Theories

Zoubeida R. Dagher, *University of Delaware*; Saouma Boujaoude, *American University of Beirut, Lebanon*

The Philosophies of Science Within One Chemistry Research Group

William Hunter, George Bodner, *Purdue University*

Development of the Beliefs About Science and School Science Questionnaire BASSSQ

Jill Aldridge, Peter Taylor, *Curtin University of Technology, Australia*

6.03 **Spring Room**

Gender Issues in Science Education

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Deidre B. Sessoms, *University of California, Davis*

Scientist, Daughter, Wife and Mommy: Enabling Factors in the lives of Six Contemporary Women Scientists

Juanita Jo Matkins, *Virginia Commonwealth University*

Enhancing Equity in Science Teaching: A Collaborative Effort

Kathryn Scantlebury, Bambi Bailey, *University of Delaware*

Views of Learning and Images of Scientists in University Science Texts: A Gender Perspective

Elizabeth Hazel, Anthony Baker, Patricia Gallagher, Robert Cheary, *University of Technology, Sydney, Australia*

Gender and Approaches to Qualitative research In Science Education: Exploring Phenomenography

Elizabeth Hazel, *University of Technology, Sydney, Australia*; Linda Conrad, *Griffith University, Australia*; Elaine Martin, *EQUARD*

6.04 **Cermak**

International Perspectives on the Alternative Evaluation of Science Curricula: Australia, Germany, Israel, and the US

(5 Curriculum, Evaluation and Assessment: Paper Set Organized by Proposer)

Presider/Discussant: Eleanor Abrams, *University of New Hampshire*

Assessing Scientific Literacy: An Alternative Assessment Study of the Elementary STS Curriculum in Israel

Ruth Zuzovsky, *Tel Aviv University, Israel*

The Meaning of Science Education for Grades 4-6 Students: Interest Structures Assessment by Multidimensional Scaling

K. H. Hansen, *Institute for Science Education, Kiel, Germany*

Teacher's Roles in the Development and Implementation of a Secondary Physics Curriculum: An Evaluation Study

Allan Feldman, *University of Massachusetts at Amherst*

Formative Evaluation of a Multimedia Program Using an Interpretive Methodology

Dorit Maor, *Curtin University of Technology, Australia*

10:30am-12:00pm Strand Sessions Saturday, March 22, 1997

6.05 Harger

Student and Teacher Perception of Natural Sciences General Education Requirement Courses

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Organized by Proposer)

Presider/Discussant: James A. Shymansky, *University of Iowa*

Interdisciplinary Courses for General Education Requirements (GER) in College Science: Perspectives of University Professors

Pradeep Maxwell Dass, *University of Iowa*

GER Students' Perspectives of Assessment Practices

Robin Lee Harris Freedman, *University of Iowa*

Success in GER Courses: A Study Based on Students' Behaviors and Attitudes, and Instructional Strategies

JoAnne Ollerenshaw Lewis, *University of Iowa*

An Examination of Gender and Retention Issues and Implication in GER Science Classes

Leigh Monhardt, Don Wick, *University of Iowa*

6.06 Hunt 1,2,3

Teachers' Beliefs and Attitudes

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Andrew Lumpe, *Southern Illinois University*

Teachers' Beliefs About Using Cooperative Learning in Science

Charlene M. Czerniak, *University of Toledo*; Andrew T. Lumpe, *Southern Illinois University*

Paradigm of Change: Doing Math the Science Way

Julie Thomas, Christine Purkiss, Sandi Cooper, *Texas Tech University*

Teacher Intentions, Teaching Practice, and Student Perception of Inquiry Oriented Teaching

Lawrence Flick, Valarie L. Dickinson, *Oregon State University*

Motivation to Teach as a Factor in the Professional Development of Preservice Science Teachers

Laura N. Rogers, *University of North Carolina at Wilmington*; Sarah Bond, *North Carolina State University*; Joanne Nottingham, *University of North Carolina at Wilmington*

6.07 Kent 1,2,3

Assessing Frameworks

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Joel Mintzes, *University of North Carolina - Wilmington*

Is There Any Change in Science Educational Reforms? - A Sociological Study of Theories of Instruction

Ana Morais, Isabel P. Neves, *University of Lisbon*

Block Schedule and Achievement of North Carolina Students

Cynthia K. Louden, *University of North Carolina at Chapel Hill*

An Assessment Framework for Science Literacy

Audrey B. Champagne, Vicky Kouba, *SUNY at Albany*

A Model for Describing Performance Assessment Tasks

Anthony Bartley, *Lakehead University*

Assessing and Promoting Reasoning Through STS Experiences In High School

Chris Lawrence, John Craven, III, *University of Iowa*; Tracy Hogan, *Cedar Falls High School*

10:30am-12:00pm **Strand Sessions** **Saturday, March 22, 1997**

6.08 Oak Brook I

Early Childhood Education

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Michael Kamen, *Auburn University*

Science and Mathematics Versus Other School Subject Areas: Pupil Attitudes Versus Parent Attitudes

Thomas Andre, Myrna Whigham, Amy Hendrickson, Sharon Chambers, *Iowa State University*

Changes in Student Views of Science Participating in a Summer Experiential Science Education Program

David Jelinek, *University of California at Santa Barbara*

A Sociocultural Model of Learning and Teaching in Early Childhood Science Education

Gilda Segal, *University of Technology, Sydney, Australia*

Classroom Factors Associated With Systemic Reform in Science and Mathematics Education

Mary Kay Kelly, *Miami University*; Joanne Tims Goodell, *Curtin University of Technology, Australia*; Arta Damnjanovic, Jane Butler Kahle, *Miami University*

6.09 Oak Brook III

The Establishment of Scientific Classroom Discourse Communities: Future Directions for Learning Context Research

(2 Learning: Classroom Contexts and Learner Characteristics: Invited Session)

Presider/Discussant: James Gee, *Clark University*

Participants:

Randy Yerrick, *East Carolina University*; Charles W. Anderson, *Michigan State University*; Kathy Roth, *Michigan State University*; Wolf-Michael Roth, *Simon Fraser University*; Maria Varelas, *University of Illinois-Chicago*

6.10 Oak Brook IV

Student Ideas in Physical Science and Their Implications for Teaching

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Patricia L. Jason, *University of North Carolina at Charlotte*

Elementary Children's Technological Problem Solving: Selecting an Initial Course of Action

Brand Gustafson, Patricia Rowel, *University of Alberta*

Students' Conceptual Change in Structural Characters on Solutions

Xiufeng Liu, *St. Francis Xavier University*

Concept Development through Inquiry-Based Projects and Related Reflections

Anita Roychoudhury, *Miami University*

Student's Perceptions of the Interview as a Means to tell What They Know

James A. Rye, *West Virginia University*

6.11 Ogden

Teachers' Personal Learning Theories: Seven Stories of Teachers Engaged in a Science Reform Project

(3 Teaching: Novel Format)

Presider/Discussant: Kathleen Davis, *University of Nevada - Las Vegas*

Participant:

Joan M. Whitworth, *Morehead State University*

10:30am-12:00pm Strand Sessions Saturday, March 22, 1997

6.12

Windsor

A Focus on Minority Students - The Teaching and Learning of Science

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Nancy J. Allen, *University of Texas - Austin*

Undermining Learning: Students And Science Teaching In An Urban School

Lee Meadows, *University of Alabama at Birmingham*

The Relationship Between Technology-Enhanced Biology Instruction and the Teaching and Learning of African-American Students

Phillip G. Eaglin, *Florida State University*

Moving Toward a Richer Understanding of Students' Interaction with Dissection: Implications from an Interpretive Study

Elizabeth C. Doster, *East Carolina University*; David F. Jackson, J. Steve Oliver, Denise Crockett, *University of Georgia*

Minority Perspectives of Teaching and Learning in Science Education

Brenda R. Brand, George E. Glasson, *Virginia Polytechnic Institute and State University*

6.13

York 1,2,3

Technology in the Classroom: Insights from the International Handbook of Education and Beyond

(7 Educational Technology: Paper Set Organized by Proposer)

Presider/Discussant: Richard White, *Monash University*

Problem Based Macro Contexts in Science Instruction: Design Issues and Applications Development

Robert B. Sherwood, Anthony J. Petrosino, Xiaodong Lin, *Vanderbilt University*

Adapting Scientific Investigation Tools to Support Authentic Science Learning

Daniel C. Edelson, Douglas Gordin, *Northwestern University*; Roy D. Pea, *SRI International*

Computer Microworlds and Scientific Inquiry: Enabling Students to Construct Conceptual Models

Barbara Y. White, Christina V. Schwarz, *University of California-Berkeley*; John R. Frederiksen, *Educational Testing Service*

Using Technology to Support Students' Artifact Construction in Science

Joseph Krajcik, Michele Wisnudel-Spitulnik, Steve Stratford, Elliot Soloway, *University of Michigan*

Using Technology to Support Conceptual Change In Science: Helping Students Learn about Light using the Internet

Phillip Bell, Marcia C. Linn, *University of California - Berkeley*

12:00pm-1:00pm Strand Session Saturday, March 22, 1997

7.01

Hunt 1,2,3

Teacher Professional Development

(4 Teacher Education: Interactive)

Presider/Discussant: Mark Ogonowski, *TERC*

Learning and Teaching Science: Teacher Professional Development as Inquiry

Mark Ogonowski, *TERC*; Angelo Collins, *Vanderbilt University*; Charles Anderson, *Michigan State University*

12:00pm-1:00pm Strand Sessions Saturday, March 22, 1997

7.02 Kent 1,2,3

Student Designed Projects

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Harry L. Shipman, *University of Delaware*

Participants:

The Three R's of Cross-Institutional Collaborations: Reform, Responsibility and Respect
Kate Scantlebury, *University of Delaware*

Design Activities in a Big, Interdisciplinary Physical Science Course
Harry L. Shipman, Ramona Philhower, *University of Delaware*

Design for Student Success: A Collaborative Effort in a Non-Science Major Biology Course
Ramona Philhower, Robert Ketcham, *University of Delaware*

7.03 Oak Brook II

Use of Concept Mapping and Simulations in Science Teaching

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: Rebecca Denning, *Ohio State University*

The Effects of Concept Mapping and Metacognitive cues in a Hypermedia-based Genetics Program
James Lehman, Pei-Ling Lee, David Eichinger, Franz Frederich, *Purdue University*

Computer Simulation as a Tool of Research in Science Teaching
Helmut Dahncke, *Kiel University*

High-Tech Concept Mapping Is People Centered: A Hands-on Review of Available Computer Software
Richard Iuli, *Medical College of Wisconsin*; Robert H. Abrams, *Cornell University*

7.04 Oak Brook III

History, Philosophy, Sociology: Contributions to Science Education

(8 History, Philosophy and Epistemology: Paper Set Grouped by Committee)

Presider/Discussant: William Hunter, *Purdue University*

The Sociology of Science as a Means to a More Inclusive, Liberatory, and Authentic Science Education
Jenifer V. Helms, *University of Colorado, Boulder*; Christine M. Cunningham, *Cornell University*

Pendulum Motion and Solving the Problem of Longitude: How History Might Contribute to Science Education
Michael R. Matthews, *University of New South Wales, Australia*

7.05 Oak Brook IV

Building Knowledge Through Informal Contexts: Initial Steps

(9 Informal Learning: Paper Set Organized by Proposer)

Presider/Discussant: John Koran, *University of Florida*

Building Knowledge Through Informal Contexts: A Teacher Education Model
Pamela Fraser-Abder, *New York University*

What Do Children Learn While Visiting a Museum Exhibit?
Allison Thau, *New York University*

Effect of Participation in Three Hands-on Museum Programs on Student Knowledge and Attitudes
Cheryl Winship, *Museum of the Hudson Highlands*

12:00pm-1:00pm Strand Sessions Saturday, March 22, 1997

7.06 **Regency A**

An Evaluation of K-12 Science and Mathematics Teacher Needs and Educational Reform in Florida

(5 Curriculum, Evaluation and Assessment: Paper Set Organized by Proposer)

Presider/Discussant: Troy D. Palmer, *Florida State University*

High School Science Teachers Needs and the State-Wide Reform of Science Education in Florida
Troy D. Palmer, *Florida State University*

Middle School Science Teacher Needs and Educational Reform in Florida
Steven Byrd, *Florida State University School*

Elementary Science and Mathematics Teacher Needs and Educational Reform in Florida
Willis C. Muire, Jr., *Florida State University*

7.07 **Regency B**

Student Ideas in Life Science and Their Implications for Teaching

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Margery Osborne, *University of Illinois at Champaign*

Children's Ideas in Science: How Do Student and Teacher Perspectives Coincide?
Valarie L. Dickinson, Lawrence B. Flick, *Oregon State University*

Elementary Children's Concepts of Living Things, Animals, and Plants in Taiwan
Yueh-Suey Shiao, *Taitung Teachers College, Taiwan*; John E. Penick, *University of Iowa*

Changes in Classroom Conceptual Environment of a Food Chain
Billie Eilam, *University of Haifa*; Miriam Reiner, *Technion-Israel Institute of Technology*

7.08 **Regency C**

Using Graphical Representation to Develop and Assess Student Ideas

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Kathleen Peasley, *Michigan State University*

Appropriation of Graphical Representation Practices in Small Group Interactions
Michael G. Bowen, *Simon Fraser University*; Wolff-Michael Roth, *University of Victoria*; Michelle McGinn, *Simon Fraser University*

Using A Modified Concept Mapping To Identify Student's Alternative Scientific Understandings of Biology
Derrick R. Lavoie, *Black Hills State University*

Using "Model Maps" - The Impact on Students' Understanding of the Nature of Science
Jennifer L. Discenna, *Western Michigan University*

7.09 **Regency D**

Discourse Which Mediates Scientific Literacy Part 1: Interpretative Lenses

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: William Carlsen, *Cornell University*

Moments of Meaning: The Context and Discourse of Understanding in an Elementary Science Class
Michael Kamen, *Auburn University*

Constructive Lenses for Viewing and Valuing Student's Activities During Inquiry in Science
David Brown, *University of Illinois at Urbana-Champaign*; Diana Beck, *Knox College*; Richard Frazier, *Singapore American School*

Sociocultural Influences On The Classroom Learning Environment
John Wallace, *Curtin University of Technology, Australia*; Ching-Yang Chou, *National Kaohsiung Normal University, Taiwan*

12:00pm-1:00pm Strand Sessions Saturday, March 22, 1997

7.10 **Regency E**

Science Teacher Education

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Eric Pyle, *West Virginia University*

Teaching Biology to Prospective Elementary Teachers: Evolution of an Instructor's Classroom Interactions

Carol Briscoe, *University of West Florida*; Ann Lumsden, *Florida State University*

Disentangling Popular Arguments: Aiming to Motivate Science Teachers and Improving Their Science Learning Environments

William G. Holliday, *University of Maryland*; Piyush Swami, *University of Cincinnati*

How Prospective Teachers Perceive Their Experienced and Preferred Physical Science Classroom Environment

Abdullah Abbas, Penny J. Gilmer, *Florida State University*

7.11 **Regency F**

Literacy, Text, and the Negotiation of Meaning

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Pat Keig, *California State University - Fullerton*

Meaningful Learning in Chemistry Classes through Original Writing

Martina Nieswandt, *University of Kiel, Germany*

Developing a Model to Enhance Writing for Learning In Secondary School Science

Brian Hand, V. Prain, *La Trobe University, Bendigo, Australia*

Visual Memory and Language: Children's Use of Art and Language to Communicate Knowledge of Science

Rita Peterson, *University of California - Irvine*

7.12 **York 1,2,3**

Instruments and Psychometric Studies

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Chin-Tang Liu, *Southwestern Missouri State University*

A Psychometric Analysis of Performance Assessment Tasks Measuring the Inferring Skills of Fourth Grade Students

Patricia M. Stohr-Hunt, *University of Richmond*

The Validity of Teacher Portfolio Assessment

Michael Lomask, Michael Seroussi, *Connecticut State Department of Education*;, Helen Regan, *Connecticut College*

Construction and Validation of an Instrument to Measure Understanding of Pattern by Elementary School Students

Donna F. Berlin, *Ohio State University*

1:00pm-2:30pm NSF Presentation Saturday, March 22, 1997

8.01 **Oak Brook II**

An Overview of NSF Programs

(Presentation Organized by Proposer)

Presider/Discussant: Janice Earle, *National Science Foundation*

An Overview of NSF Programs

Janice Earle, James D. Ellis, Larry E. Suter, *National Science Foundation*

1:00pm-2:30pm Strand Sessions Saturday, March 22, 1997

8.02 **Hunt 1,2,3**

Teacher Professional Development

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Keith Lucas, *Queensland University of Technology, Australia*

Stimulating Professional Development Through the Use of Interviews and an Observation Rubric

Paul Adams, *Ft. Hays State University*; Gerald H. Krockover, *Purdue University*

Meeting the Challenge of Professional Development: Design and Evaluation of a Telecommunications Mediated STS Course

Dana Zeidler, *University of South Florida-Tampa*; John F. LeBaron, *University of Massachusetts - Lowell*; Barbara Spector, *University of South Florida*

8.03 **Kent 1,2,3**

Texas Statewide Systemic Initiative

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: James McNamara, *Texas A&M University*

Setting the Stage for Strengthening the Science Preparation of Elementary Teachers in Texas

Carol Stuessy, *Texas A&M University*; Julie A. Thomas, *Texas Tech University*

A Description of Preservice Elementary Science Programs at Colleges and Universities in Texas

Dawn Parker, *Texas A&M University*

Elementary Science Presidential Awardee Teacher Interviews

Andrea Foster, *Texas A&M University*

Texas Poll of Elementary School Teachers

Dawn Parker, Debbie Jensen, *Texas A&M University*

8.04 **Oak Brook I**

Perspectives on Inquiry-oriented teaching practice

(3 Teaching: Symposium)

Presider/Discussant: Wolf-Michael Roth, *Simon Fraser University*

Participants:

Lawrence B. Flick, *Oregon State University*; Carolyn Keys, Susan Westbrook, *Georgia State University*; Barbara Crawford, *Oregon State University*; Nathan Carnes, *University of South Carolina*

8.05 **Harger**

Science as Discourse: An Interactive Symposium Surrounding One Second Grade Classroom

(2 Learning: Classroom Contexts and Learner Characteristics: Novel Format)

Presider/Discussant: James Gee, *Clark University*

"How Much Light Does a Plant Need?" Questions, Data and Theories in a Second-Grade Classroom

Gillian M. Puttick, *TERC*; Kenneth Tobin, *Florida State University*; Richard Duschl, *Vanderbilt University*

8.06 **Oak Brook III**

Science Education for All??? Can We Achieve Educational Equity Without an Antiracist Critique?

(6 Cultural, Social and Gender Issues: Invited Session)

Presider/Discussant: Leslie S. Jones, *Ohio State University*

Participants:

Leslie S. Jones, *Ohio State University*; Glen S. Aikenhead, *University of Saskatchewan*; Mary M. Atwater, *University of Georgia*; Ohkee Lee, *University of Miami*; Sharon Lynch, *George Washington University*; Alberto Rodriguez, *University of Wisconsin-Madison*

1:00pm-2:30pm Strand Sessions Saturday, March 22, 1997

8.07 **Regency A**

Developing and Assessing Student Understanding in Chemistry

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Mark Guy, *University of North Dakota*

Structural Variation in Concept Maps about Acid-Base Equilibrium: A Comparative Study of Experts and Novices

Janice M. Wilson, *Griffith University, Australia*

Assessing Students' Microscopic-level Understandings of Common Chemical Phenomena

Soo-Young Lee, Shirley Magnusson, *University of Michigan*

Improving Chemistry Achievement of Young Women Using a Multi-Dimensional Conceptual Approach

Dorothy L. Gabel, *Indiana University*; Diane M. Bunce, *Catholic University of America*

Lab-Activities in Light of Critical Thinking

Mauricia Oliveira, Belina T. Vieira, *University of Lisbon*

8.08 **Regency B**

Learner Process Studies in Physics: An Integration of Perspectives

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Organized by Proposer)

Presiders/Discussants: Dewey Dykstra, *Boise State University*; Miriam Reiner, *Technion, Israel*

Learning Pathways in High-School Level Quantum Atomic Physics.

Hans Niedderer, Jurgen Petri, *University of Bremen*

Conceptual Change During a Unit on Chaos Theory Induced by Means of Analogies

Reinders Duit, Michael Komorek, *Institute for Science Education, Kiel, Germany*; Wolff-Michael Roth, *University of Victoria*

Cognition during 'Hands-on' Physics: Toward a Theory of Knowing and Learning in Real Time.

Wolff-Michael Roth, *University of Victoria*; Reinders Duit, Michael Komorek, Jens Wilbers, *Institute for Science Education, Kiel, Germany*

Student Understandings of the Balance Beam: Variations Within and Across Contexts

Michelle K. McGinn, *Simon Fraser University*; Wolff-Michael Roth, *University of Victoria*

The Emergence of Understandings of Electricity: Increasing Complexity of Discursive and Material Actions

Manuela Welzel, Stefan von Aufschnaiter, *University of Bremen*

8.09 **Regency C**

Gender Issues in Science Learning Contexts

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Gail Richmond, *Michigan State University*

Gender Difference in Teacher-Student Interaction in High and Low-Achieving Middle School Biology Classes

Hsiao-Ching She, *National Chiao Tung University, Taiwan*

Remediation of Gender Inequity in Science in a Developing Country: An Experiment with Cooperative Concept-Mapping

Uzoamaka Irene Ngozi Osisioma, *Nnamdi Azikiwe University, Nigeria*

Teacher-Student Interpersonal Behaviour, Cultural Background and Gender in Science Classes

Tony W. Rickards, Darrell L. Fisher, Barry J. Fraser, *Curtin University of Technology, Australia*

Relationships of Student Gender, Personal Epistemological Beliefs, Science Self-efficacy, Attitude, and Subjective Norm to Intended High School Science Class Enrollment

Charlotte Haselhuhn, *Des Moines Public Schools*; Thomas Andre, *Iowa State University*

1:00pm-2:30pm **Strand Sessions** **Saturday, March 22, 1997**

8.10 **Regency D**

Future Directions for Learning Contexts Research

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Organized by Proposer)

Presider/Discussant: Herbert J. Walberg, *University of Illinois at Chicago*

Progress and Prospect in Research on Science Learning Environments

Barry Fraser, *Curtin University of Technology, Australia*

The Teacher's Contribution to the Social Climate of the Classroom

Theo Wubbels, *Utrecht University, The Netherlands*

Research Involving Personal Forms of Learning Environment Instruments

Campbell J. McRobbie, *Queensland University of Technology, Australia*; Darrell L. Fisher, *Curtin University of Technology, Australia*

The Potential of Semiotic Interpretation of Learning Environments

Bonnie Shapiro, *University of Calgary*

8.11 **Regency E**

Learning with Models in Elementary School Science

(7 Educational Technology: Paper Set Organized by Proposer)

Presider/Discussant: David Geelan, *Curtin University of Technology, Australia*

Static No More! Students beliefs About Models and Science

Cecil D. Robinson, *University of Colorado*

Models Children Build: Content, Logic, and Educational Impact

Catherine Brand, Heidi Carlone, Clayton Lewis, Cyndi Rader, *University of Colorado*

Factory Goop, Albino mice, X-rays: Exploring Students' Explanations of Mutation via Student-generated Computer Models

Heidi Carlone, *University of Colorado*

Of Models, Meanings, and Misconceptions

Cyndi Rader, Catherine Brand, Page Pulver, *University of Colorado*

8.12 **Regency F**

Thinking and Learning in Science

(8 History, Philosophy and Epistemology: Paper Set Grouped by Committee)

Presider/Discussant: Fouad Abd-El-Khalick, *Oregon State University*

Searching for a Fifth Stage of Intellectual Development in College Biology

Anton E. Lawson, Nicole Drake, Jennifer Johnson, Yong-Ju Kwon, Christopher Scarpone, *Arizona State University*

Constructivism: Excellent Theory for Explicating the Practice of Science and Science Teaching

John R. Staver, *Kansas State University*

Towards a Viable Constructivism for the Science Classroom

Obed Norman, *Washington State University*

A Biological Basis for Generative Learning in Science

Lynette Schaverien, Mark Cosgrove, *University of Technology, Sydney, Australia*

1:00pm-2:30pm Strand Sessions Saturday, March 22, 1997

8.13 York 1,2,3

Voices of Reform

(5 Curriculum, Evaluation and Assessment: Paper Set Organized by Proposer)

Presider/Discussant: Ron Anderson, *University of Colorado*

Voices of Reform: Student Free-Response Performance on Items Developed from a Standardized Test

Sandra Enger, *University of Iowa*

Voices of Reform: Student and Teachers on Assessment in the Classroom

Robin Lee Harris Freedman, Matthew S. Beisel,*University of Iowa*

Voices of Reform: Partners – Teacher to Teacher

Mark F. Trax, *University of Iowa*

Voices of Reform: The Expert Science Teacher and the Relationship of Beliefs to Practice

Gary F. Varrella, Robert E. Yager, *University of Iowa*

Voices of Reform: The Administrator's Faint Voice, but Vital Role

Janet B. Robinson, *University of Iowa*

Voices of Reform: The Project Evaluator

Judith Burry-Stock, *University of Alabama*

2:45pm-3:45pm Strand Sessions Saturday, March 22, 1997

9.01 Hunt 1,2,3

Preservice Teacher Education

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: John Cannon, *University of Nevada-Reno*

Mentoring the Beginning Science Teacher: Interpersonal Influences on Learning to Teach

Jeanie Roberson, Margaret W. Smithey, Carolyn M. Evertson, *Peabody College at Vanderbilt University*

The Effect of the Student Teacher and Supervising Teacher on One Another's Teaching of Science

Olga S. Jarrett, Pamela T. Stana, *Georgia State University*

The Effect of the Addition of a Practicum Experience to an Elementary Science Methods Course

Scott B. Watson, Linda James, Susan Mizell, *East Carolina University*

9.02 Kent 1,2,3

Elementary Science Teacher Preparation

(4 Teacher Education: Symposium)

Presider/Discussant: Kim Nichols, *University of Alabama*

Integrating Knowledge Bases: An Upper-Elementary Teacher Preparation Program

Joseph S. Krajcik, Mary L. Starr, *University of Michigan*; Carla M. Zembal-Saul, *Louisiana State University*

Elementary Preservice Teachers' Use of Content Specific

Mary L. Starr, *University of Michigan*

The Role of Cycles of Instruction in Preservice Elementary Teachers' Science Content Representations

Carla M. Zembal-Saul, *Louisiana State University*

2:45pm-3:45pm Strand Sessions Saturday, March 22, 1997

9.03 **Oak Brook I**

Models for University Science Instruction

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Robert Bleicher, *University of California - Santa Cruz*

Using Peer-Facilitated Structured Study Groups (SSG) Within a Large First-Year University Chemistry Program

Brian P. Coppola, Scott T. Lefurgy, *University of Michigan*; Douglas S. Daniels, *Scripps Research Institute*

An Experimental Approach for Testing an Innovative Instructional Model for an Introductory College Biology Course

Diane Ebert-May, Julie Baldwin, Dennis J. Burns, *Northern Arizona University*

Results of Utilizing a Research-based Conceptual Course Development Model For a Large Enrollment Astronomy Class

Walter Bisard, *Central Michigan University*

9.04 **Oak Brook II**

Impacts of Software on Student Learning

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: Cathy Loving, *Texas A & M University*

Learning by Acting: Secondary Students' Environmental Project Work Mediated by a Geographic Information Systems Approach

Timothy P. Olsen, *University of Wisconsin-Madison*; Joseph Zaiman, *Edgewood High School*

The Effect of Using Computerized Molecular Modeling on High School Chemistry Students' Performance

Nitza Barnea, Yehudit J. Dori, *Technion-Israel Institute of Technology*

The Use of Computer Animated Molecular Models to Visualize Stereochemistry

Michael R. Abraham, Valsamma Varghese, *University of Oklahoma*

9.05 **Oak Brook III**

Research Using Ethnography, Oral History or Heuristics

(8 History, Philosophy and Epistemology: Paper Set Grouped by Committee)

Presider/Discussant: Mick Nott, *Sheffield Hallam University, UK*

The "Commonplaces" of Science as an analytical tool for science teachers, teacher educators, and researchers

Jenifer V. Helms, *University of Colorado, Boulder*

Establishing Credibility and Authenticity in Ethnographic Studies

John S. Schaller, Kenneth Tobin, *Florida State University*

Science Teachers of the Twentieth Century: An Intergenerational Oral History Project

Kathleen Filkins, *University of Southern Indiana*; Debra Heath, *Durham Intermediate School*

9.06 **Oak Brook IV**

Exploring How Students Develop Understanding in Science

(1 Learning: Students' Conceptions and Conceptual Change: Round Tables)

Initiating Change in Students' Achievement and Alternative Frameworks Through a Problem Solving Based Instructional Model

Chun-Yen Chang, *National Taiwan Normal University*; James P. Barufaldi, *University of Texas at Austin*

Parallelism in the Development of Historical Theories and Children's Ideas About Projectile Motion

Maria Kozhevnikov, Shulamith Graus Eckstein, *Technion-Israel Institute of Technology*

Formative Assessment and Conceptual Change in Preservice Middle Grades Teachers' Understanding of Physical Science

Darwin W. Smith, Katherine C. Wieseman, *University of Georgia*

Learning Strategies in Science: A Case Study of A Deep Approach Learner

Christine Chin, *University of Illinois at Champaign-Urbana*

9.07 **Oak Brook IV**

Roundtable in Teacher Education

(4 Teacher Education: Round Tables)

Applying Learning Environment Ideas in Teacher Education: Improving University and School Classrooms

Alan Yarrow, Jan Milwater, *Queensland University of Technology, Australia*; Barry J. Fraser, *Curtin University of Technology, Australia*

Teacher Interns Experience Alternative Views of Knowledge Acquisition

Patricia L. Jason, *University of North Carolina - Charlotte*

Teachers' Beliefs Concerning Constructivist Teaching Practices in the Science Classroom

Jodi Haney, Julia McArthur, *Bowling Green State University*

9.08 **Oak Brook IV**

What Makes Successful Science Education Projects

(5 Curriculum, Evaluation and Assessment: Round Tables)

Chairpersons Perceptions on Intensive Scheduling in Six High Schools: Implications for Science Education Reform

Dorothy R. Walter, Thomas M. Dana, *Penn State University*

What Makes Successful Science Education Projects: The Problematics of Teacher Input

John Barnett, *Independent Scholar*

Development of Conceptions on Mechanics in Indian School Science Textbooks

Ravinder Koul, *Penn State University*

9.09 **Regency A**

Teaching the Learning Cycle

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Larry Enochs, *University of Wisconsin - Milwaukee*

Preservice Elementary Teachers' Self-Efficacy and the Relationships to Their Understanding of the Learning Cycle

John Settlage, *Cleveland State University*

Self-Efficacy and Anxiety of Preservice and Inservice Elementary Teachers Related to Learning

Coralee Smith, *University of Alabama*

Preservice Versus Inservice Teachers' Understanding of, and Confidence in Their Knowledge

A. Louis Odom, *University of Missouri-Kansas City*

9.10 **Regency B**

Assessing Programs

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Gary Varrella, *University of Iowa*

Race, Gender, Test Length, and Missing Data. Why Estimates of Performance may be Clouded.

William J. Boone, *Indiana University*; Steven R. Rogg, Jane Butler Kahle, Arta Damnjanovic, *Miami University*

Assessing the Impact of an Urban Systemic Professional Development Program on Classroom Practice.

Mary Stein, John Norman, *Wayne State University*; Juanita Clay Chambers, *Detroit Public Schools*

Reform and Reality: Observations of Texas Teachers on a Biology End-of-Course-Examination

Julie F. Westerlund, *University of Texas at Austin*

2:45pm-3:45pm **Strand Session** **Saturday, March 22, 1997**

9.11 **Regency C**

Developing Biological Concept Understanding: Three Case Studies

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Michael E. Beeth, *Ohio State University*

Refining Conceptual Change Theory: Examining the Influence of Student Characteristics, Conceptual Domain, and Research Epistemology

Sherry A. Southerland, *University of Utah*

Students' Conceptions of Learning and Memory

Jens Christoph Schletter, Horst Bayrhuber, *Institute for Science Education, Kiel, Germany*

A Multi-Dimensional Interpretive Framework for Understanding Conceptual Change Learning

David F. Treagust, Grady Venville, Allan Harrison, Louise Tyson, *Curtin University of Technology, Australia*

9.12 **Regency D**

Using Pre-Service Teacher Prior Conceptions to Develop Understanding About Plants

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Joel Mintzes, *University of North Carolina*

Some Contributions for a Pedagogical Treatment of Alternative Conceptions: An Example From Plant Nutrition

Maria Helena Rijo Carola, Adelaide Neto Vaz, António J. Neto, *Universidade De Évora, Portugal*

Student Concepts of Tidal Salt Marshes: What We Learn from Interviewing Students Before We Teach

Elizabeth A. Day, Christine Ebert, *University of South Carolina*

Conceptual Change: A Study of the Concept of Photosynthesis in Pre-Service Teachers

Herminia Pedro, *Escola Superior de Educaçáo de Lisboa, Portugal*

9.13 **Regency E**

Narrative Voices in Science Education

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Frank Crawley, *East Carolina University*

The Effect of Inservice Training and Teachers' Action Research on Elementary Science Classroom Environments

Becky Barton Sinclair, *University of Texas at Dallas*; Barry J. Fraser, *Curtin University of Technology, Australia*

Weaving Narrative Nets to Capture School Science Classrooms

David Geelan, *Curtin University of Technology, Australia*

"It's Amazing What You Can Hear Yourself Saying": Learning to Teach Science Through Dialogue and Reflection

Judith Johnson, *University of Central Florida*

9.14 **Regency F**

Discourse Which Mediates Scientific Literacy Part 2: Classroom Talk

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Deborah Tippins, *University of Georgia*

Opportunities to Talk Science in the Classroom.

Robert E. Bleicher, *University of California - Santa Cruz*; Campbell J. McRobbie, *Queensland University of Technology*; Kenneth Tobin, *Florida State University*

Comparative Cognitive Models of Teacher/Student and Student/Student Knowledge-Building Discourse

Kathleen Hogan, *University at Albany, SUNY*

But I Explained It So Carefully: An Analysis of Teacher Explanations in Physical Science

Paul Hobden, *University of Natal, South Africa*

4:00pm-5:00pm Invited Session Saturday, March 22, 1997

10.01 **NARST President's Suite**

Invited Session for Past Presidents

Presider: Thomas R. Koballa, Jr., *University of Georgia*

4:00pm-5:30pm Strand Sessions Saturday, March 22, 1997

10.02 **Hunt 1,2,3**

Content Courses for Preservice Teachers

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Larry Scharmann, *Kansas State University*

Evaluating an Earth Science Course for Prospective Elementary School Teachers
Troy D. Palmer, *Florida State University*

A Substantive Theory of How Preservice Elementary Education Majors Experience Learning in an Alternative Content
David T. Crowther, *University of Nevada-Reno*; Ron J. Bonnstetter, *University of Nebraska-Lincoln*

Measuring Differences Between Ecosystems: Task Dynamics in a College Biology Course for Prospective Elementary Teachers
Hedy Moscovici, *Western Washington University*

Elementary Preservice Teachers' Content Knowledge: Effects of an Integrated Content Oriented Science Methods Course
Janice K. Doby, *Florida Atlantic University*

10.03 **Kent 1,2,3**

Science, Technology and Society

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Billie Eilam, *University of Haifa, Israel*

Modeling School Effectiveness in Science Teaching: Validating a School Effectiveness Model and Constructing an Indicator System
Ruth Zuzovsky, *Tel Aviv University, Israel*; Murray Aitkin, *University of Western Australia*

Science Teachers as Curriculum Developers of Science and Technology for All
Avi Hofstein, Rachel Mamlok, Miriam Carmeli, *Weizmann Institute of Science, Israel*

10.04 **Oak Brook I**

Teacher Knowledge

(3 Teaching: Paper Set Grouped by Committee)

Presider/Discussant: Julie Gess-Newsome, *University of Utah*

An Examination of Teacher Journals to Discern Teacher Reflective Thinking
Huey-Fang Ju, *Taiwan Elementary Teacher Inservice Institute*

The Pedagogical Content Knowledge of Prospective and Experienced Chemistry Teachers
Onno De Jong, *Utrecht University, The Netherlands*

Expectations of Expertise: The Case of an Elementary School Science Specialist
Suzanne A. Siner, *Stanford University*

Expert Science Teaching: A Russian American Comparison
Judith A. Burry-Stock, *University of Alabama*

10.05 **Oak Brook II**

School Change Through Action Research

(4 Teacher Education: Symposium)

Building the Capacity for Sustainable School Change Through Teacher Research
Judith Johnson, *University of Central Florida*

4:00pm-5:30pm Strand Sessions Saturday, March 22, 1997

10.06
Oak Brook IV

Gender, Cultural and Social Issues

(6 Cultural, Social and Gender Issues: Round Tables)

A Female-friendly Model for Learning and Teaching Science
Teresa Arambula-Greenfield, *University of Hawaii*

Indigenous Models for Science-and-Culture Curriculum Development
Nancy J. Allen, *University of Texas at Austin*

Mentors and Menaces: Teachers and Graduate Advisors of Women Who Are Now Academic Biologists
Anne-Marie Scholer, *Endicott College*

Underrepresentation of African Americans in Science: Re-examining Current Explanations
Bradford F. Lewis, *University of Pittsburgh*

10.07
Oak Brook IV

Studying Learning Interactions in Informal Settings

(9 Informal Learning: Round Tables)

Teacher-Student Interactions at a Children's Discovery Center
Anne Marshall Cox, William F. McComas, *University of Southern California*

Partnerships and the Contributions of Informal Teaching Experiences to Teacher Education
Janet M. Johnson, *Cranbrook Institute of Science*; Dawn Pickard, *Oakland University*; Colleen O' Keefe, *Cranbrook Institute of Science*

Signs Saying "Under Construction": Children's Worldmaking in an Urban Environment
Sally Middlebrooks, *Association of Science-Technology Centers, Inc.*

Play and Emerging Scientific Literacy
Maureen McMahon, *University of California, Davis*; Nancy W. Wiltz, Christine M. Kelly, *University of Maryland*; Gregory R. Potter, *University of California, Davis*

When Science Education Faculty Return to the Classroom: The Tale of Two City's Professors
John Settlage, *Cleveland State University*; Charlene Czerniak, *University of Toledo*

10.08
Regency A

The School Science Curriculum: Many Choices for Policy Makers, Many Meanings for Students

(5 Curriculum, Evaluation and Assessment: Symposium)

Presider/Discussant: Douglas A. Roberts, *University of Calgary*

Participants:
Douglas A. Roberts, *University of Calgary*; Glen S. Aikenhead, *University of Saskatchewan*; Arthur N. Geddis, *University of Western Ontario*; Graham Orpwood, *York University*; Leif Ostman, *Uppsala University, Sweden*; Brent Kilbourn, *University of Toronto*

10.09
Regency B

Using Problem Solving Strategies to Develop Understanding in Physics

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Walt Bisard, *Central Michigan University*

Mathematical Dimensions of Students' Use of Proportional Reasoning in High School Physics
Ayo Harriet Akatugba, John Wallace, *Curtin University of Technology, Australia*

Enhancing Conceptual Understanding: Modifying Standard Examples In Geometrical Optics
Amarjit Singh Dhillon, *University of Auckland, New Zealand*

Conceptual Change in Science Through Collaborative Learning at the Computer
Ping-Kee Tao, *University of Hong Kong*; Richard Gunstone, *Monash University, Australia*

Problem Solving in Physics: Towards a Synergetic Metacognitively Developed Approach
António J. Neto, *University of Évora, Portugal*; Maria Odete Valente, *University of Lisbon, Portugal*

4:00pm-5:30pm Strand Sessions Saturday, March 22, 1997

10.10 **Regency C**

Problem Solving as a Venue for Examining Scientific Literacy

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Bambi Bailey, *University of Delaware*

Constructing Understandings of the Mole Concept: Interactions of Chemistry Texts, Teachers, and Learners
Jane O. Larson, *DODEA, Yokota High School*

Promoting Problem-Solving in Science Through Concept-Mapping and Cooperative Learning
Peter Okebukola, *Lagos State University, Nigeria*; Olugbemiro J. Jegede, *University of Southern Queensland, Australia*

Examining Teacher-Student Interactions in Classroom Environments Using Story-Telling and Problem Solving in Authentic Contexts
Helen Parke, *East Carolina University*

Using Problem-Based Learning to Improve Diagnostic Reasoning Skills for at Risk Students
Rebecca Denning, Philip J. Smith, *Ohio State University*

A Novice/Expert Study of Science Writing: Moving from Data to Meaningful Inference
Carolyn Keys, *Georgia State University*

10.11 **Regency D**

Kids as Global Scientists: Research on Teachers, Students, and Curriculum

(7 Educational Technology: Paper Set Organized by Proposer)

Presider/Discussant: Nancy Butler Songer, *University of Colorado*

Student Achievement and Experience in an Internet-Based Project
Megan Mistler-Jackson, *University of Colorado*

KGS and the National Science Education Standards
Janet Carlson Powell, *University of Colorado*

The Teacher's Role in Educational Reform
Christine Yorker, *University of Colorado*

Fostering Teachers' Listserve Discourse and its Impact on Student Learning
Peter Hester, *University of Colorado*

10.12 **Regency F**

Religion and Science Education: Arguments in the Special Issue of *Science and Education*

(8 History, Philosophy and Epistemology: Symposium)

Presider/Discussant: Michael Matthews, *University of New South Wales*

Participants:
Andrea Foster, Cathleen C. Loving, *Texas A&M University*; John Staver, *Kansas State University*; William W. Cobern, *Western Michigan University*

10.13 **York 1,2,3**

Science Curriculum Implementation: Perspectives From the International Handbook of Science Education

(5 Curriculum, Evaluation and Assessment: Symposium)

Presider/Discussant: Robert James, *Texas A&M University*

Participants:
Jan van den Akker, *University of Twente, The Netherlands*; Rodger Bybee, *National Research Council*; Nava Ben-Zvi, *Hebrew University of Jerusalem, Israel*; John Wallace, *Curtin University of Technology, Australia*; William Louden, *Edith Cowan University, Australia*; Wilmad Kuider, *University of Twente, The Netherlands*; Ronald D. Anderson, *University of Colorado*

5:30pm-8:30pm Meeting and Dinner Saturday, March 22, 1997

JRST Editorial Board Meeting and Dinner **Oak Brook III**

7:00am-8:00am Meetings Sunday, March 23, 1997

Publications Advisory Committee	**Hunt 1**
Ad Hoc Committee on Recruiting and Retaining Members	**Hunt 2**
Graduate Students and New Researchers Committee	**Hunt 3**
Election Committee	**Kent 1**
Research Committee	**Kent 2**
Ad Hoc Political Action Committee	**Kent 3**
Liaison with Scientific Societies Committee	**York 1**

8:30AM-10:00am General Session Sunday, March 23, 1997

11.01 **Regency Ballroom**

What Do We Know and How Do We Know It? The Role of Theory in Science Education

Presider/Discussant: Kathleen Fisher, *San Diego State University*

Participants:

Members of the NARST Board of Directors

10:30am-12:00pm Strand Sessions Sunday, March 23, 1997

12.01 **Butterfield**

Sociology of Science: Methodological Issues and Challenges

(8 History, Philosophy and Epistemology: Discussion Group)

Probing Teachers' Beliefs About the Social Nature of Science, Using a Web-Resident Computer Adaptive Test

William S. Carlsen, *Cornell University*

Needed: New Methods to Assess Sociological Understanding of Science and Analyze its Manifestations in Classrooms

Christine M. Cunningham, *Cornell University*

Using Ethnographic Analysis to Study School Science in the Making

Gregory Kelly, Catherine Chen, Teresa Crawford, *University of California, Santa Barbara*

12.02 **Cermak**

Making a Difference: Creating Feminist Activist Agendas in Science Education Research and Teaching

(6 Cultural, Social and Gender Issues: Novel Format)

Presider/Discussant: Kathy Roth, *Michigan State University*

Participants:

Elaine Virginia Howes, *Michigan State University*; Angela Calabrese Barton, *Columbia University*; Lynne Cavazos, *University of California at Santa Barbara*; Lori Kurth, Paula Lane, Gail Richmond, Kathy Roth, *Michigan State University*

10:30am-12:00pm Strand Sessions Sunday, March 23, 1997

12.03 Harger

Issues, Experiences, and Problem-Solving in Non-Formal Learning Contexts

(9 Informal Learning: Paper Set Grouped by Committee)

Presider/Discussant: Michael Kamen, *Auburn University*

Schools and Science Centres Working Together: An STS Issues-Based Approach to Science Learning
Laura Wang Nielsen, *University of British Columbia*; Erminia Pedretti, *OISE/University of Toronto*

Relationships Among Informal Learning Environments, Teaching Procedures and Scientific Reasoning Ability
Brian L. Gerber, *Valdosta State University*; Ann M. L. Cavallo, Edmund A. Marek, *University of Oklahoma*

Characterizing Effective Environmental Education and Its Impact on Students' Environmental Activities
Fletcher Brown, *University of Montana*

12.04 Hunt 1,2,3

Teacher Education

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: J. Steve Oliver, *University of Georgia*

A Problem-based Approach for Preservice Science Teacher Education
Raymond F. Peterson, *University of Adelaide, Australia*; David F. Treagust, *Curtin University of Technology, Australia*

Program Influences, Change and the Mediating Influences of School Culture: Development of New Science Teachers
Sheryl McGlamery, Doug MacIsaac, *University of Northern Colorado*

Socialization Influences on a Beginning Teacher Prepared as a Constructivist Educator
Margaret Bolick, Emmett L. Wright, *Kansas State University*

The Search for Routes to a Common Ground for the Building of a Community of Co-Learners
Sharon Parsons, *San Jose State University*

Teaching for Excellence: Using Project 2061 Benchmarks for More Effective Science Instruction
Penny Hammrich, *Temple University*; Kerri L. Armstrong, *Philadelphia, PA*

12.05 Kent 1,2,3

Laboratory Instruction

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Joseph Schmuckler, *Temple University*

Profile of Instructional Practices in Beginning College Level Chemistry Lab Experiences
Alexandra Hilosky, *Harcum College*

Exploring the Impact of Longer-term Intervention on Reforming Physical Science Teachers
William J. Priestley, *Temple University*

Exploring the Impact of Longer Term Intervention of Reforming Biological Science Teachers
Holly Priestley, *Temple University*

12.06 Oak Brook I

Teachers Conducting Science Research

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Nancy T. Davis, *Florida State University*

Teachers Learning Science by Doing Science
Penny J. Gilmer, *Florida State University*

A Science Teacher's Contextual Learning Experience: Conducting Environmental Research
Lori Hahn, *Florida State University*

A Teacher Immersed in Scientific Research: Its Influence on Her Teaching
Kathy Foley, *Florida State University*

Teachers' Immersion in Authentic Scientific Research
Jacqua Ballas, Terri Kielborn, *Florida State University*

10:30am-12:00pm Strand Sessions Sunday, March 23, 1997

12.07 **Oak Brook II**

Assessing Classes

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Glenda Carter, *North Carolina State University*

Development of an Instrument to Measure Teacher Candidates' Attitudes and Beliefs About Mathematics and Science

Randy McGinnis, *University of Maryland, College Park*; Tad Watanabe, *Towson State University*; Gilli Saama, Anna Graeber, *University of Maryland, College Park*

Using Classroom Environment Dimensions in the Evaluation of Adult Computer Classes in Singapore

Hock Seng Khoo, Barry J. Fraser, *Curtin University of Technology, Australia*

Laboratory Learning Environments and Practical Tasks in Senior Secondary Science Classes

Darrell Fisher, Allan Harrison, *Curtin University of Technology, Australia*; David Henderson, *Launceton College*; Avi Hofstein, *Weizmann Institute of Science, Israel*

Effects of a First-Year Chemistry Laboratory Program Requiring Students to Develop Their Own Experiments

Alan Blakely, *University of California, Davis*

12.08 **Oak Brook III**

Beliefs Which Populate Science Learning Environments

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Diane Ebert-May, *Northern Arizona University*

College Students' Post-Hoc Attitudes Toward and Descriptions of Their High School Learning Environments

Christopher F. Bauer, *University of New Hampshire*

Science: It's a Very Good Subject If...

Wendy Speering, Léonie Rennie, *Curtin University of Technology, Australia*

Cultural Learning Environments in Science Classrooms: Validity and Application of a Questionnaire

Bruce G. Waldrip, Darrell L. Fisher, *Curtin University of Technology, Australia*

Student Attitudes Toward Science in a Grade-5 Integrated Learning Environment

Elizabeth Gibson, Maureen McMahon, *University of California, Davis*

An Assessment of Student Perceptions of the Actual and Ideal State of Undergraduate Laboratory Instruction

William McComas, Hsingchi Wang, Linda S. Bazilian, *University of Southern California*

12.09 **Oak Brook IV**

Exploring the Future of Science Teaching: Going Beyond the Classroom

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: Robert Sherwood, *Vanderbilt University*

Transformative Uses of Technology for Teaching Biology in Developmental Education Settings

Murray Jensen, *University of Minnesota*

Exploring a Future for Education: Eisenhower National Clearinghouse as a Prototype of Electronic Resource

Michael H. Klapper, *Ohio State University*

The Promise and Perils of Network Science

Bob Coulter, Joe Walters, *TERC*

An Investigation of the Use of the WWW for Sustained Inquiry in a Science Classroom

David Lyons, Joseph Hoffman, Joseph Krajcik, Elliot Soloway, *University of Michigan*

10:30am-12:00pm Strand Sessions Sunday, March 23, 1997

12.10

Ogden

Science Teaching

(3 Teaching: Paper Set Grouped by Committee)

Presider/Discussant: Cathy Yeotis, *Wichita State University*

A Model of Desired Performance in Phylogenetic Tree Construction for Teaching Evolution
Steven D. Brewer, *University of Massachusetts*

The Development of a Test of Knowledge about Biodiversity
John Norman, Ajayi Olabisi, *Wayne State University*

Effectiveness of Demonstrations in Facilitating Physics Concept Acquisition
Kenneth W. Gattis, John Park, *North Carolina State University*

Teachers' Emphasis on Inquiry Science and Prevailing Instructional Method
Kinya Shimizu, *The Chicago Academy of Sciences*

12.11

Windsor

Science Learning and Multicultural Environments

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Alberto J. Rodriguez, *University of Wisconsin - Madison*

Multicultural Learning Environments: Influence of Culture on Science Learning
Geoff Giddings, Bruce Waldrip, *Curtin University of Technology, Australia*

Cultural Diversity and the Challenges of Teaching Science
Kenneth Tobin, Chris Muire, Nancy Davis, *Florida State University*

Science Conceptions among Linguistically Diverse Students
Okhee Lee, Sandra H. Fradd, *University of Miami*; Frank X. Sutman, *Temple University*

12.12

York 1,2,3

An Analysis of College Science Courses: Chemistry and Biology

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Ling L. Liang, *Indiana University - Bloomington*

College Students' Self Assessment in HOCS and LOCS Chemistry Examinations
Uri Zoller, *Haifa University-Oranim, Israel*; Georgios Tasparlis, *University of Ioannina, Greece*; Michael Fastow, Aviva Lubezky, *Haifa University-Oranim, Israel*

Student Learning of Science Embedded in its Cultural Context: Discovery of the Structure of DNA
William J. Letts IV, *University of Delaware*

An Alternative Mode of Instruction: A Detailed Analysis of Three Units in an Organic Chemistry Course
Kirsten Lowrey, George M. Bodner, G. Marc Loudon, *Purdue University*

Science Content Courses for Pre-Service Teachers: A Balancing Act of Teaching/Learning Strategies
Kathie Black, *University of Victoria*

Biology Laboratory Investigations in British Columbia High Schools and their Effect on Provincial Examination Scores
Peter Gardiner, *University of Victoria*

12:00pm-2:30pm Luncheon Sunday, March 23, 1997

NARST Annual Awards Luncheon **Regency Ballroom and Essex**

2:30pm-3:30pm **Strand Sessions** **Sunday, March 23, 1997**

13.01 **Butterfield**

Implications of Alternative Teaching Strategies in Developing Student Understanding

(1 Learning: Students' Conceptions and Conceptual Change: Discussion Group)

Hypermedia for Relational Conceptual Change
Jazlin V. Ebenezer, *University of Manitoba*

Group Impact on Individual Problem Solving within the Undergraduate Genetics Course
H. Sunny Buttles, *Our Lady of the Lake University*; Duane F. Shell, *University of Nebraska - Lincoln*

Connected Learning in a Competency-Based Curriculum
Ron Saranchuk, *Canadian Memorial Chiropractic College*

13.02 **Cermak**

Evaluating Social Context Learning in Informal Settings

(9 Informal Learning: Paper Set Grouped by Committee)

Presider/Discussant: David Anderson, *Queensland University of Technology, Australia*

Impact of Front End Evaluation on Exhibit Design in a Science Center
Rosemary F. Leary, *Educational Consultant*; Laura Martin, *Arizona Science Center*

Does Narrative Belong in a Science Center?
Laura Martin, *Arizona Science Center*; Rosemary F. Leary, *Educational Consultant*

A Responsive Constructivist Evaluation of A Self-Guided Activity Trail
Edward C. Lucy, Ted S. Wansley, *Georgia State University*

13.03 **Harger**

Cooperative Learning: An International Perspective

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Organized by Proposer)

Presider/Discussant: Rebecca Denning, *The Ohio State University*

Learning Science in the Cooperative Mode in Junior and Senior High Schools
Reuven Lazarowitz, Yehudit Dori, *Technion-Israel Institute of Technology*; Jehuda Huppert, *Haifa University, Israel*

Cooperative Learning in Preservice Teacher Education: A Synthesis of Three Applications
Lawrence C. Scharmann, *Kansas State University*

13.04 **Hunt 1,2,3**

Poster Session

(1 Learning: Students' Conceptions and Conceptual Change: Poster Session)

Students' and Teachers' Mental Models of Germs and Illness
Melissa Rua, Gail Jones, *University of North Carolina at Chapel Hill*

(3 Teaching: Poster Session)

Manipulatives in the Elementary Science Classroom
Edward L. Shaw, *University of South Alabama*; Mary Hatfield, *Arizona State University*

An Interpretive Study on Instructional Representations of a High School Biology Teacher
Teresa Ping Lee, Huang, Iris, *National Kaohsiung Normal University, Taiwan*

2:30pm-3:30pm Strand Sessions Sunday, March 23, 1997

13.04 (continued) Hunt 1,2,3

Poster Session

(5 Curriculum, Evaluation and Assessment: Poster Session)

Results of a National Survey on Assessment-of-Student-Learning Practices in College Chemistry
Craig W. Bowen, Rosalind Slavings, Noal Cochran, *University of Southern Mississippi*

A Comparison of Teacher Attitudes Toward Writing In Science and the Writing Activities Students Do
Rebecca M. Monhardt, *Utah State University*

How Do Students Perceive a Multi-Dimensional Performance Assessment During Tasks Activity in Biology
Miriam Welicker, Reuven Lazarowitz, *Technion-Israel Institute of Technology*

Relationship Among Integrated Science Process Skills, Logical Thinking Abilities, and Academic Achievement
Ismail Jusoh, Zurida Ismail, *Universiti Sains Malaysia, Penang*

(6 Cultural, Social and Gender Issues: Poster Session)

Gender and Parental and Elementary Pupils Attitudes about Science and Mathematics
Myrna Whigham, *Iowa State University*

Equity, Bias, and Attitudes among Middle School Science Students
R. Lynn Jones, *University of Texas at Austin*

Change of Major Patterns between Females and Males in Science and Mathematics Education
Martha Schriver, Jay Strickland, *Georgia Southern University*

The Resilience of Girls in Science: A Model Project
Penny L. Hammrich, *Temple University*

(9 Informal Learning: Poster Session)

Parents as Informal Science Teachers: Twelve Case Studies Broaden Continuing Research
Phyllis Katz, *University of Maryland*

Examining Connections Between Time-Based Behaviors at a Science Museum: The Emergence of the Interested Visitor
Cody Sandifer, *Reuben Fleet Science Center*

Visitors' Apparent Need for Direction When Learning Science at a Museum of Natural History
Dana Riley Black, *Harvard College Observatory*

13.05 Kent 1,2,3

Exploring How Students Develop Understanding of Biological Concepts

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: David Treagust, *Curtin University of Technology, Australia*

Jamaican Students' Understanding of the Processes of Diffusion, Osmosis and Absorption Across Living Cells
Kola Soyibo, *University of the West Indies, Jamaica*; Marcia Andrade, *University of Technology, Jamaica*

Secondary Students' Perceptions of Scientific Research from Project-Based Classrooms
Eleanor Abrams, David Moss, Judy R. Kull, *University of New Hampshire*

Meaningful Understanding of Genetics Topics Among Underrepresented, Advanced High School Students in a Health Sciences Program
Ann M. L. Cavallo, *University of Oklahoma*; Kristina Coats, *Blanchard Public Schools*; Martin Shaffer, *Seaman High School*; Wendy Taylor, *University of Oklahoma*

2:30pm-3:30pm Strand Sessions Sunday, March 23, 1997

13.06 Oak Brook II

The Role of Concepts in Learning Contexts

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Robin Lee Harris Freedman, *University of Iowa*

How Students in a Scientific Apprenticeship Program Use Multiple Communities as Resources for Conceptual Growth

Gail Richmond, Lori A. Kurth, *Michigan State University*

The Three C's: Concept, Content, and Context in the Teaching of Physics

Helen Wildy, John Wallace, *Curtin University of Technology, Australia*

Challenging Prevailing Assumptions About the Use of Metaphoric Statements in the Acquisition of Science Conceptions

Mark Sandomir, *Mountain View High School*; Robert J. Stahl, *Arizona State University*

13.07 Oak Brook III

Evaluation of Instructional Approaches Using Technology

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: Helmut Dahncke, *Institute for Science Education, Kiel, Germany*

Evaluating Computer Lab Modules for Large Biology Classes

David C. Eichinger, Mary B. Nakhleh, Deanna Auberry, *Purdue University*

How Plate Tectonic Computer Animation Affects Geology Students' Learning and Attitudes Towards Computer-Assisted Instruction

Hyewon Kim, *University of Texas at Austin*

"Solids & Light": An Instruction Unit that Introduces Quantum Principles by Using Light Emitting Diodes

Lawrence T. Escalada, Sanjay N. Rebello, Heidi M. Gruner, Dean A. Zollman, *Kansas State University*

13.08 Oak Brook IV

Teaching Science Methods to Women: Three Tales of Men Professors Reflecting on Their Practices

(6 Cultural, Social and Gender Issues: Symposium)

Presider/Discussant: Geoff J. Giddings, *Curtin University of Technology, Australia*

Participants:

J. Randy McGinnis, *University of Maryland-College Park*; Kenneth Tobin, *Florida State University*; Thomas R. Koballa Jr., *University of Georgia*

13.09 York 1,2,3

Exploring How Students Develop and Make Distinctions About Ideas in Science

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: David F. Jackson, *University of Georgia*

Can Students Distinguish Between Science and Technology

John Trowbridge, *Southeastern Louisiana University*; James Wandersee, *Louisiana State University*

Modifying the Learning Cycle Model to Enhance Students' Construction of Science Content, Concepts and Conceptions

Brett A. Barker, Robert J. Stahl, *Arizona State University*

Visual Communication in the Learning of Science

Isabel Martins, Gunther Kress, Jon Ogborn, Kieran McGillicuddy, *University of London, UK*

4:00pm-5:00pm Strand Sessions Sunday, March 23, 1997

14.01

Hunt 1,2,3

Poster Session

(1 Learning: Students' Conceptions and Conceptual Change: Poster Session)

Science at Home: Where do Students Find It?
Gilbert L. Naizer, *Ohio State University at Newark*

Learning from Practice: Impressions from Pictures of Scientists Don't Tell the Whole Story
Joy E. Bielenberg, *Albertson College of Idaho*

Scientist as "Self" and "Other": Changing Images of Scientists in a Middle-School Project-Based Science Classroom
Valerie L. Talsma, *University of Michigan*

Longitudinal Understanding of the Nature of Science Facilitated By An Introductory High School Biology Course
Michael P. Clough, *University of Iowa*

Effectiveness of Interactive Historical Vignettes in Enhancing HS Students' Understanding of the Nature of Science
Ke-Sheng Chan, *University of Texas at Austin*

Comparison of Teacher-Directed and Student-Directed Journals on Achievement in College Chemistry
Catherine Anderson, *University of Texas at Austin*

Children's Trade Books: Do They Affect the Development of Science Concepts
Diana Rice, Christy Snipes, *University of South Carolina-Aiken*

(8 History, Philosophy and Epistemology: Poster Session)

What Constitutes a Scientific Explanation?
Judith R. Edgington, *University of Texas at Austin*

14.02

Kent 1,2,3

Evaluation of Science Education Reform

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Larry Yore, *University of Victoria*

An Evaluation of the Effect of the SS&C Curriculum on Ninth Grade Students
Frances Lawrenz, *University of Minnesota*; Douglas Huffman, *University of Minnesota*

Evaluating New Grade-1 Science Curriculum Taiwan: An Analysis of Children's Observation Process Skills
Jong-Pyng Chyuan, *National Taipei Teachers College*

The Effectiveness of a Science Education Reform Program with Respect to Ninth-Grade Student Achievement
Chin-Tang Liu, *Southwest Missouri State University*

14.03

Oak Brook I

Using Research in Museums to Understand Learning in Science

(9 Informal Learning: Paper Set Organized by Proposer)

Presider/Discussant: John H. Falk, *Science Learning, Inc.*

Conducting Science Learning Research in Museums: Challenges and Opportunities
Lynn D. Dierking, John H. Falk, *Science Learning Inc.*

A Triangulation Strategy to Measure Children's Learning Outcomes from An Interactive Exhibit
Terence P. McClafferty, Léonie Rennie, *Curtin University of Technology, Australia*

Investigating Long-Term Museum Learning: A Pilot Study
John H. Falk, Lynn D. Dierking, *Science Learning Inc.*

A Quasi-Experimental Study of Science Learning and Motivation in Informal Science Settings
Hannu Salmi, *Heureka Science Centre, Finland*

4:00pm-5:00pm Strand Session Sunday, March 23, 1997

14.04 **Spring Room**

Science Learning and Multicultural Environments

(6 Cultural, Social and Gender Issues: Novel Format)

A Continuing Saga: Journeys in Multiculturalism

Mary M. Atwater, Denise Crockett, Tonjua Freeman, *University Of Georgia*

14.05 **Spring Room**

Theoretical Perspectives for Science Education

(8 History, Philosophy and Epistemology: Discussion Group)

Kelly's Personal Construct Theory

Paul E. Adams, *Fort Hays State University*

A Vygotskian Perspective on Learning Science

Daniel P. Shepardson, *Purdue University*

Critical Educational Studies in Science Education

William C. Kyle, Jr., *University of Missouri - St. Louis*

14.06 **Regency A**

Review of Instructional Material for Middle School Science

(5 Curriculum, Evaluation and Assessment: Paper Set Organized by Proposer)

Presider/Discussant: James D. Ellis, *National Science Foundation*

A Review of the NSF Portfolio of Comprehensive Instructional Materials

James D. Ellis, Janice Earle, *National Science Foundation*

Identifying Curriculum Materials for Science Literacy: A Project 2061 Analysis Tool

Sofia Kesidou, Jo Ellen Roseman, *American Association for the Advancement of Science*

Conducting a Standards-Based Inventory of Middle-Level Science Curricular Materials

Steven R. Rogg, Jane Butler Kahle, *Miami University of Ohio*

14.07 **Regency B**

Using Surveys to Assess Student Ideas About Biological Concepts

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Grouped by Committee)

Presider/Discussant: Sherry Southerland, *University of Utah*

Relationships Between Acceptance or Rejection of Evolution by College Freshmen and Non-Religiously-Oriented Factors

Brian J. Alters, *Harvard University*; William B. Michael, *University of Southern California*

Students' Conceptions in Genetics

Gili Marbach-Ad, Ruth Stavy, *Tel-Aviv University, Israel*

The Impact of Nature Experience on Environmental Action

Susanne Boegeholz, Jürgen Mayer, *Institute for Science Education, Kiel, Germany*

14.08 **Regency C**

Science Teacher Education

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Organized by Proposer)

Presider/Discussant: Melissa Rua, *University of North Carolina – Chapel Hill*

Tool Usage by Ninth Graders to Mediate Learning about Circuits

Glenda Carter, Susan Westbrook, *North Carolina State University*

Science Teachers' Conceptual Growth Within Vygotsky's Zone of Proximal Development

M. Gail Jones, Melissa Rua, *University of North Carolina – Chapel Hill*; Glenda Carter, *North Carolina State University*

Whose Class Is This?: Reflections of a Teaching Researcher

Susan L. Westbrook, Glenda Carter, *North Carolina State University*

4:00pm-5:00pm Strand Sessions Sunday, March 23, 1997

14.09 Regency D

Making Sense of Teaching and Learning in Classrooms Using Technology

(7 Educational Technology: Paper Set Grouped by Committee)

Presider/Discussant: R. Paul Vellom, *The Ohio State University*

Technological Artifacts Created by Secondary Science Students: Examining Structure, Content, and Behavior of Dynamic Models
Steven J. Stratford, *Marinatha Baptist Bible College*

The Impact of Teaching Strategies and Resources on Group Dynamics and Student Learning
Rebecca Denning, Philip J. Smith, *Ohio State University*

Technology, Text, and Talk: Students' Perspectives on Learning in a Technology Enhanced Secondary Science Classroom
Erminia Pedretti, *OISE/University of Toronto*; Janice Woodrow, Jolie Mayer-Smith, *University of British Columbia*

An Examination of Elementary Student Dialogue While Using Microcomputer-Based Laboratories to Study Motion
Mary Ellen Durham, *Wesleyan College*; John C. Park, *North Carolina State University*

14.10 Regency E

Teacher Beliefs and Barriers to Science Education Reform

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Elizabeth C. Doster, *East Carolina University*

Generating Prospective Elementary Teachers' Personal Understandings about the Phenomena of Science Teaching and Learning
Sharon E. Nichols-Thompson, *University of Texas at Austin*; Deborah Tippins, *University of Georgia*

Empowering Teachers: A Critical Ethnography of a Multicultural Science Reform
Susan B. Koba, *Omaha Public Schools*

14.11 Regency F

Teacher Beliefs

(3 Teaching: Paper Set Grouped by Committee)

Presider/Discussant: Fred Finley, *University of Minnesota*

Elementary Science Teachers' Beliefs Regarding Instruction in Science
Ahmad Nurulazam Zain, Ismail Jusoh, Zurida Ismail, Abdul Hadi Ismail, *Universiti Sains Malaysia*

An Autobiographical Retrospective: Inquiry Into Beliefs Regarding Middle School Science
Katherine C. Wieseman, *University of Georgia*

14.12 York 1,2,3

Networking and Teacher Questioning

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: John Barnett, *Independent Scholar*

Assessing the Cognitive Level of Teachers' Questioning in Class Discourse Homework Assignment and Tests
Anat Zohar, Pinchas Tamir, Noa Schwarzer, *Hebrew University of Jerusalem, Israel*

Work, Schoolwork, Networks: Linking Partners and Courses in Applied Science
Jim Gaskell, *University of British Columbia*

6:00pm-7:00pm Special Interest Groups Sunday, March 23, 1997

1. Learning: Student's Conceptions and Conceptual Change	Regency A
2. Learning: Classroom Contexts and Learner Characteristics	Regency B
3. Teaching	Regency C
4. Teacher Education	Regency D
5. Curriculum, Evaluation and Assessment	Regency E
6. Cultural, Social and Gender Issues	Regency F
7. Educational Technology	Oak Brook I
8. History, Philosophy and Epistemology	Oak Brook II
9. Informal Learning	Oak Brook III

6:00pm-7:30pm Dinner Sunday, March 23, 1997

Next Generation of Researchers Dinner Chat Oak Brook IV

8:00pm-9:00pm Entertainment Sunday, March 23, 1997

15.01 Regency Ballroom

At the End of the Strands You Will Find the Fringe

Humorist:

John Settlage, *Cleveland State University*

7:00am-8:00am Meetings Monday, March 24, 1997

Program Committee	Butterfield
NARST Presentations at Other Professional Meetings Committee	Cermak
NARST-Net Ad Hoc Committee	Harger
Small College Networking Ad Hoc Committee	Ogden
Financial Advisory Committee	Windsor

8:30am-10:00am Strand Session Monday, March 24, 1997

16.01 Hunt 1,2,3

Teacher Professional Development

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: John Settlage, *Cleveland State University*

Reprising our Science Training: Teachers' Perspective on Sense-Making in Professional Development

Kathryn Powell, *University of New Mexico*

Long Term Impact of Inservice Education: Participants Revisited a Year Later

Ellen Van den Berg, *University of Twente, The Netherlands*

Understanding National Standards: An Evaluation of a Professional Development Program for Mathematics Teachers

Michael Svec, *Rockhurst College*

Science Teachers and the Master's Program They Select: A Preliminary Study

Martha L. Narro, Jeanne Slaughter, Julie L. Wilson, *University of Arizona*

8:30am-10:00am Strand Sessions Monday, March 24, 1997

16.02

Kent 1,2,3

Teaching Inquiry and Process Skills

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Charlene Czerniak, *University of Toledo*

The Effect of a Research/Education Experience on Elementary Teachers' Attitudes Toward Science and Process Skills

Vicki M. Williamson, *Illinois State University*

The Use of Science Processes in Secondary Science Laboratories: A Comparison Between Veteran and Non-Veteran Missouri Science Teachers

Paul J. Germann, Lloyd H. Barrow, *University of Missouri*

Examining Communities of Practice as a Professional Development Model to Promote Guided Inquiry Science Teaching in the Elementary Grades

Shirley J. Magnusson, Annemarie S. Palincsar, Danielle Ford, Nancy Brown, Nancy Marano, *University of Michigan*

A Preservice Teacher's Design of Inquiry-based Instruction: A Collaborative Case Study

Barbara Crawford, *Oregon State University*

Cultures in Conflict: The Role of Teacher Knowledge in Inquiry Science Lessons

Mary Dickinson Bird, Herman G. Weller, *University of Maine*

16.03

Oak Brook I

Teacher Learning

(3 Teaching: Paper Set Grouped by Committee)

Presider/Discussant: Norman G. Lederman, *Oregon State University*

Constructivism, Social Constructivism, and Soviet Activity Theory: Interpreting the Learning Experiences of Two Middle-Grade Science Teachers

Barbara G. Ladewski, *University of Michigan*

Examining Elementary Teachers' Explanations of Their Science Content Knowledge

Anita Greenwood, Michelle Scribner-MacLean, *University of Lowell*

How the Tensions of Communication Between Elementary Teachers Shape Curriculum Implementation

Kevin Leander, Margery Osborne, *University of Illinois at Urbana-Champaign*

Suddenly a Science Teacher: Understanding the Transition through Socialization

Stacey E. Marlow, Angela Callahan, *University of Hawaii at Manoa*

16.04

Regency A

Curriculum Reform in Elementary Science Program

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Keith McElroy, *Washington State University*

Individual Classroom Variation in the Implementation of Pasadena's District-Wide Hands-on Science Curriculum

Sherrill L. Minch, James M. Bower, *California Institute of Technology*

An Autopsy of an Elementary Science Program Implementation

John R. Cannon, David Crowther, *University of Nevada, Reno*

Implementation of a New Constructivist Science Curriculum for Prospective Elementary Teachers

Ling L. Liang, *Indiana University - Bloomington*

Curriculum and Policy Reform (CPR) in Florida: Conservative Populist Rhetoric or Critical Progressive Restructuring?

Willis C. Muire, Jr., *Florida State University*

8:30am-10:00am **Strand Sessions** **Monday, March 24, 1997**

16.05 **Regency B**

Cognitive Acceleration Through Science: 16 Years and Still Accelerating

(1 Learning: Students' Conceptions and Conceptual Change: Paper Set Organized by Proposer)

Presider/Discussant: Dennis Sunal, *University of Alabama*

New Evidence of the Effect of Case
Michael Shayer, *King's College London, UK*

Charting Teacher Development on The Case Project
Christine Harrison, *King's College London, UK*

Learning Strategies, Motivation and Case Teaching
Ulrike Burrmann, *University of Potsdam, Germany*

16.06 **Regency C**

The CoVis Project: A National Testbed for Science Learning Reform

(7 Educational Technology: Novel Format)

Presider/Discussant: Marcia C. Linn, *University of California - Berkeley*

Participants:

Barry J. Fishman, Louis Gomez, *Northwestern University*; Roy Pea, *SRI International*; Daniel Edelson, Eileen Lento, Laura D'Amico, Douglas Gordin, Kevin O'Neill, Joseph Polman, Greg Shrader, *Northwestern University*; Judith Lachance-Whitcomb, *Jordan Community School*; Rory Wagner, *New Trier High School*

16.07 **Regency D**

Issues of Power Politics: Obstacles, Dilemmas, and Tensions Faced by Women

(6 Cultural, Social and Gender Issues: Paper Set Organized by Proposer)

Presider/Discussant: Lee Meadows, *University of Alabama - Birmingham*

Women Engineering Students' Views of the Gender-Sensitivity of their Science Teachers
Lesley Newhouse-Maiden, Lesley H. Parker, *Curtin University of Technology, Australia*

Single-Sex Grouping as a Strategy for Constructing Gender-Sensitive Communities for Girls in Science
Lesley H. Parker, Léonie Rennie, *Curtin University of Technology, Australia*

The Fate of an All Girls' Physics Class: A Reflection of Society
MaryAnn Varanka-Martin, *Estes Park High School*

Meeting Women's and Girls' Special Needs: "Gender-sensitive" Environments and the Roadblocks Women Science Educators Face
Kathleen S. Davis, *University of Nevada*

16.08 **Regency F**

The Good, the Speculative, the Vague and the Unique: Science Teachers' Stories

(8 History, Philosophy and Epistemology: Novel Format)

Presider/Discussant: Jenifer Helms, *University of Colorado - Boulder*

Participant:

Mick Nott, *Sheffield Hallam University, UK*

16.09 **York 1,2,3**

Linking Teacher Preparation to Teacher Performance

(4 Teacher Education: Symposium)

Presider/Discussant: Joyce Parker, *Michigan State University*

Participants:

Don Duggan-Haas, Quasim Alshannag, *Michigan State University*; Lizete Carvalho, Washington Carvalho, *Universidade Estadual Paulista, Brazil*; Fernando Cajas, James Gallagher, Joyce Parker, *Michigan State University*

10:30am-12:00pm General Sessions Monday, March 24, 1997

17.01 **Oak Brook II**

The Relevance of Science Literacy

(Symposium)

Presider/Discussant: Thomas R. Koballa, Jr., *University of Georgia*

Participants:

Wolfgang Graeber, Claus Bolte, *Institute for Science Education, Kiel, Germany*; Jürgen Baumert, *Max Planck Institute, Germany*; H. Jürgen Becker, *University of Paderborn, Germany*; Wolfgang Bunder, *Institute for Science Education, Kiel, Germany*; Rodger W. Bybee, *National Research Council*; George E. DeBoer, *Colgate University*; Reinhard Demuth, *Christian Albrecht University, Germany*; Robert H. Evans, *Wake Forest University*; James J. Gallagher, *Michigan State University*; J. Dudley Herron, *Morehead State University*; John Holman, *Watford Grammar School, UK*; Thomas R. Koballa, Jr., *University of Georgia*; Olaf Koller, *Max Planck Institute, Germany*; Jon D. Miller, *The International Center for the Advancement of Scientific Literacy*; Jürgen Oelkers, *University of Bern, Switzerland*; Susan Paik, *University of Illinois at Chicago*; John Ramsey, *University of Houston*; Svein Sjoberg, *University of Oslo, Norway*; Sylvia Ware, *American Chemical Society*

17.02 **Oak Brook IV**

Publishing in NARST Publications

(Novel Format)

Presider: Kathleen Roth, *Michigan State University*

Participants:

Kathleen Roth, *Michigan State University*; William Kyle, Jr., *University of Missouri - St. Louis*; Randy Yerrick, *East Carolina University*

10:30am-12:00pm Strand Sessions Monday, March 24, 1997

17.03 **Oak Brook I**

Formal and Informal Assessments of Views on the Nature of Science

(8 History, Philosophy and Epistemology: Symposium)

Presider/Discussant: Norman G. Lederman, *Oregon State University*

Participants:

Cathleen Loving, *Texas A&M University*; Norman G. Lederman, *Oregon State University*; Jill Aldridge, *Curtin University of Technology, Australia*; Nancy Brickhouse, *University of Delaware*; Catherine Cummins, *Louisiana State University*; William Cobern, *Western Michigan University*; William Letts, *University of Delaware*

17.04 **Hunt 1,2,3**

Action Research in Teacher Education

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Nancy J. Allen, *University of Texas - Austin*

Action, Reflection, What's Next?: Our Story

Tung-Hsing Hsiung, *National Taitung Teachers College, Taiwan*; Chao-Ti Hsiung, *National Taipei Teachers College, Taiwan*; Zen-Hsin Wang, *National Taitung Teachers College, Taiwan*

Action Research in Gender Issues in Science

Joyce Nyhof-Young, *Ontario Institute for Studies in Education*

Performance Assessment with Preservice Elementary Teachers: Does it Measure Up?

Mark Guy, Jacki Wilcox, *University of North Dakota*

Interdisciplinary Collaboration in Science, Education and Technology: Support and Hindrance

Angelo Collins, Lynn Bercaw, Todd Gary, Amy Palmeri, *Vanderbilt University*

10:30am-12:00pm **Strand Sessions** **Monday, March 24, 1997**

17.05

Kent 1,2,3

Teacher Education

(4 Teacher Education: Paper Set Grouped by Committee)

Presider/Discussant: Reuven Lazarowitz, *Israel Institute of Technology*

Links Between Preservice Preparation, Teaching, and Learner Outcomes: Salish I Findings from Iowa

John A. Craven, III, *University of Iowa*

Effects of Elementary Science Methods Course on Preservice Teachers' Understanding of the Nature of Science

Julie Gess-Newsome, Richard Statler, Sherry A. Southerland, *University of Utah*

Changing Constructs of Secondary Science Student Teachers: Using Concept Maps to Trace the Pedagogical Thinking

Meta Van Sickle, *University and College of Charleston*; Carolyn Dickman, *Radford University*; John Sears, *Nottingham, UK*; Katherine Norman, *California State University - San Marcos*

Learning to Teach in a Diverse Setting: A Case Study of a Multicultural Science Education Enthusiast

Julie Wilson, *University of Arizona*

17.06

Oak Brook III

Science and Secondary Schools

(2 Learning: Classroom Contexts and Learner Characteristics: Paper Set Grouped by Committee)

Presider/Discussant: Amanda Woods McConney, *Oregon State College*

Scaffolding Science Inquiry through Transformative Communication

Joseph Polman, *Northwestern University*; Roy D. Pea, *SRI International*

Strategies Exhibited by High School Biology Students During Laboratories

Laura Barden, *Western Illinois University*

Inquiry Through Design: Situating and Supporting Inquiry through Design Projects in High School Science Classes

Eric Baumgartner, Brian J. Reiser, *Northwestern University*

Scientists as Mentors to Students in Research Laboratories

Robert E. Bleicher, *University of California, Santa Cruz*

17.07

Regency A

Middle School Teacher Professional Development

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Linda Ramey-Gassert, *Wright State University*

Designing an Environmental Science-Based Professional Development Program to Affect Change in Middle School Teacher Teams

Jerry A. Bell, *American Association for the Advancement of Science*

Stages of Conceptual Change That Enable Teachers to Adopt a Student-Centered Approach to Hands-On, Inquiry-Based Teaching

Donna Sterling, *George Mason University*

Factors Associated with Successful Implementation of Environmental Science Units by Interdisciplinary Teams

Ann Howe, *North Carolina State University*

The Influence of Teachers' Attitudes on Their Adoption of Student-Centered Pedagogy

Arlene Olkin, *George Mason University*

10:30am-12:00pm Strand Sessions Monday, March 24, 1997

17.08

Regency B

Science Education in the Context of Global Perspective

(5 Curriculum, Evaluation and Assessment: Paper Set Grouped by Committee)

Presider/Discussant: Thomas M. Dana, *Penn State University*

Scientific Culture and Science Education in Europe: An Analysis of Science Curriculum

Isabel Chagas, *Universidade De Lisboa, Portugal*; M. Teresa Oliveira, *Universidade Nova De Lisboa, Portugal*; Giuseppe Marucci, *Ministry of Education, Italy*

Reforms. Visions and Standards: A Cross-Curricular View from an Elementary School Perspective

Larry D. Yore, Carole Ford, Robert J. Anthony, *University of Victoria*

An Analysis of Current Middle School Science Curriculum Programs

Andrew T. Lumpe, *Southern Illinois University*; Jodi J. Haney, *Bowling Green State University*

Culture and the Success Criteria for Expatriate National and Non-National in Curriculum Development

David B. Deru, Joseph P. Riley II, *University of Georgia*

17.09

Regency C

Non-Traditional Forms of Assessment in University Science and Science Education Courses

(5 Curriculum, Evaluation and Assessment: Symposium)

Presider/Discussant: Nancy T. Davis, *Florida State University*

Participants:

Willis C. Muire, Jr., Abdullah Abbas, Penny Gilmer, Nancy T. Davis, *Florida State University*

17.10

Regency D

District-wide Implementation of Gender and Cultural Sensitivity in the Science Classroom: A Supervisor's Perspective

(6 Cultural, Social and Gender Issues: Paper Set Grouped by Committee)

Presider/Discussant: Audrey Champagne, *University at Albany, SUNY*

Ohio SSI Factors Associated With Urban Middle School Science Achievement: Differences By Student Sex and Race

Arta Damnjanovic, Jane Butler Kahle, *Miami University*

District-wide Implementation of Gender and Cultural Sensitivity in the Science Classroom: A Supervisor's Perspective

Annette Miele Saturnelli, *Newburgh Enlarged School District*

Preparing Teachers to Teach in Multi-Cultural Communities

Pamela Fraser-Abder, *New York University*

Teachers as Reflective Practitioners

Diane Lennon, Karen Wolner, *Newburgh Enlarged School District*

17.11

Regency E

Alternative Genres in Science Education

(8 History, Philosophy and Epistemology: Paper Set Organized by Proposer)

Presider/Discussant: Kenneth Tobin, *Florida State University*

In Search of Quality in Interpretive Research: Some Stories Read and Some Judgements Made

John Wallace, *Curtin University of Technology, Australia*

Telling Tales that Show the Brushstrokes

Peter Taylor, *Curtin University of Technology, Australia*

To Care or Not to Care?

Vaille Dawson, *Curtin University of Technology, Australia*

Impressionistic Tales, Surrealistic Tales: Exploring Critical Classroom Events Through Fictionalised Stories

David Geelan, *Curtin University of Technology, Australia*

10:30am-12:00pm Strand Sessions Monday, March 24, 1997

17.12 **Regency F**

Argumentative Analysis: Epistemology and Discourse in Science Education

(8 History, Philosophy and Epistemology: Paper Set Organized by Proposer)

Presider/Discussant: Christine Cunningham, *Cornell University*

Analyzing the Content of Students' Arguments through the Toulmin Model of Argumentation

Stephen L. Druker, Gregory J. Kelly, *University of California - Santa Barbara*

Argument in High School Genetics

M. Pilar Jiménez-Aleixandre, Anxela Bugallo-Rodriguez, *Universidade de Santiago de Compostela, Chile*; Richard A. Duschl, *Vanderbilt University*

Never Ask a Question if You Don't Know the Answer

William Carlsen, *Cornell University*

17.13 **Regency D**

Liberatory Science Education: Rethinking Pedagogical Practice from Feminist Perspectives

(6 Cultural, Social and Gender Issues: Symposium)

Presider/Discussant: Angela Calabrese Barton, *Columbia University*

Participants:

Angela Calabrese Barton, *Columbia University*; Margery D. Osborne, *University of Illinois*; Sherry Nichols, *University of Texas*; Deborah Tippins, *University of Georgia*; Constanza Hazelwood, *Interlocken Fine Arts Academy*; Lynne Cavazos, *University of California - Santa Barbara*; Matthew Weinstein, *Macalaster University*; Elaine Howes, *Michigan State University*

17.14 **York 1,2,3**

Science Research Experiences in Teacher Education: Radio Astronomy as a Baseline Context for Constructing Understandings of the Processes of Science

(4 Teacher Education: Paper Set Organized by Proposer)

Presider/Discussant: Josephine Wallace, *University of North Carolina-Charlotte*

History and Development of Teacher Institutes at the National Radio Astronomy Observatory

Patricia Obenauf, *West Virginia University*; Sue Ann Heatherly, *NRAO - Greenbank*; Eric J. Pyle, *West Virginia University*

Inservice and Preservice Teacher Research Experiences: Impact on Views of Science

Sue Ann Heatherly, *NRAO - Greenbank*; Aimee Barden, Eric J. Pyle, Debra Hemle, Patricia Obenauf, *West Virginia University*

Development and Testing of a Suite of Instruments for Assessing the Impact of Research-Oriented Science Teaching

Bruce Gansneder, *University of Virginia*; Debra Hemler, Aimee Barden, *West Virginia University*

12:30pm-4:00pm Meeting Monday, March 24, 1997

NARST Executive Board Meeting #2 **Ogden**

Special Notice

NARST members may wish to take note of this specially scheduled session to be held at the AERA meeting in Chicago, following the NARST conference in Oak Brook:

Remembering Mary Budd Rowe: Timely Research by a Tireless Researcher

Reception and presentation at the annual meeting of the American Educational Research Association, sponsored by the National Association for Research in Science Teaching, Stanford University, and the University of Florida
Wednesday, March 26, 1997, 6:15 - 7:45 pm
Hyatt, West Tower, Concourse Level, Gold Coast Room

PART C

Abstracts

Edited by
David Jackson
Stacy Gomes

Abbas, Abdullah **Session 7.10** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency E

How Prospective Teachers Perceive Their Experienced and Preferred Physical Science Classroom Environment

Penny J. Gilmer

The purpose of this study was to investigate how students in a class for prospective elementary teachers perceived their experienced and preferred learning environment in terms of involvement, commitment, autonomy, relevance, and inhibitors. The primary data sources in the study were the Learning Environment Survey (LES), interviews with the instructor and the selected students, field notes, and journals of students. A constructivist framework was used in conjunction with interpretive approach to study the preferred and experienced learning environments in a physical science classroom. Findings with respect to the involvement autonomy, commitment, relevance, and inhibitors indicated that students preferred a better environment of learning in their class. In the relevance dimension, the students would like more time to think about concepts that the instructor presents. Also they prefer activities to be more interesting, and have the lessons deal more with real problems. The findings and implications of the study can provide bases for the future reform of college science teaching and learning for prospective teachers.

Abd-El-Khalick, Fouad **Session 6.02** **Saturday, March 22, 1997**
10:30am-12:00pm
Butterfield

The Nature of Science and Instructional Practice: Making the Unnatural Natural

Randy Bell **Norman G. Lederman**

The purpose of this study was to explicate preservice science teachers' conceptions of the NOS and elucidate the relationship between these conceptions and their instructional planning and classroom practice. Fourteen preservice secondary science teachers participated in the study. Participants were administered an open-ended questionnaire to assess their conceptions of the NOS. The participants' daily lesson plans, classroom videotapes, portfolios, curriculum projects, and supervisors' field-notes served as data sources. These were analyzed for evidence of planning for and/or teaching aspects of the NOS during student teaching. Participants were interviewed to validate their questionnaire responses, generate in-depth profiles of their views, and verify and revise the evidence derived from other data sources. Analyses indicated that participants' views were consistent with contemporary conceptions of the NOS. However, there was no evidence that they planned for and/or taught the NOS. Participants articulated several reasons for not teaching the NOS. They viewed the NOS as less significant than other instructional outcomes, expressed feelings of inadequacy regarding their understanding of and ability to teach and assess the NOS, and finally noted several restrictions invoked by their cooperating teachers. The study suggests that teachers' intentions are a critical factor in translating their conceptions of science into classroom practice.

Abraham, Michael R. **Session 9.04** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook II

The Use of Computer Animated Molecular Models to Visualize Stereochemistry

Valsamma Varghese

Computers are used in different ways for educational purposes and the use of computer animated visuals to assist instruction has recently attracted the attention of educational researchers. This study explored the relative effectiveness of three kinds of molecular representations on college students comprehension of stereochemistry concepts. The experimental treatments involved instructional activities including the use of computer animated models, hand-held ball and stick models, and two-dimensional representation of molecules. This study also investigated the relationship of spatial ability and gender on achievement. The results indicate that students in the computer animated group had significantly higher scores on the achievement test than the students in the other two treatment groups and the control group.

Abrams, Eleanor **Session 13.05** **Sunday, March 23, 1997**
2:30pm-3:30pm
Kent 1,2,3

Secondary Students' Perceptions of Scientific Research from Project-Based Classrooms

David Moss **Judy R. Kull**

The purpose of this study was to measure any change in the conceptions of in students about the nature of scientific research and the concept of systems after one year in project-based classrooms. In one class, the students developed individual projects centered around a common class theme of whaling that addressed specific processes and content. In the other class, students were involved in a series of "student as scientist" projects throughout the year. Interview data, notes from weekly classroom observations and the use of classroom artifacts were used in an effort to triangulate findings. In spite of the differences of the two high schools' projects, students' conceptual understanding of the research process changed throughout the year. Students questioning ability refined and the process of how to conduct that research grew. Student presentations consistently improved an the ongoing learning process. The focus and the amount of change varied depending upon the context of the class and the focus of the teacher. Students in the "student as scientist" model learned more about systems than the independent project class, however, both groups of students' conceptions remain rudimentary.

Adams, Paul **Session 8.02** **Saturday, March 22, 1997**
1:00pm-2:30pm
Hunt 1,2,3

Stimulating Professional Development Through the Use of Interviews and an Observation Rubric

Gerald H. Krockover

The purpose of this study was to determine the impact of the use of the Secondary Science Teacher Analysis Matrix and the Teachers' Pedagogical Philosophy Interview on the praxis of a secondary biology teacher during the first three years of the teacher's career. The perceived and exhibited impact of these instruments was determined through direct classroom observations, video tapes, and formal and informal interviews over a period of three school years. The findings indicate that these instruments prompted the teacher to reconstrue conceptions of teaching and learning through recall of significant preservice program experiences, after the initial stress of teaching had been resolved. The implication is that the preservice program experiences may not become significant to teachers until a few years into their careers and that use of instruments such as these can play a significant role in the professional development of beginning science teachers.

Adams, Paul E. **Session 14.05** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook III

Kelly's Personal Construct Theory

This paper presents an overview of Kelly's Personal Construct Theory. The fundamental postulate of this theory is: "A person's processes are psychologically channelized by the ways in which he anticipates events" (Kelly, 1955, p. 6). Constructs are the reference axes that individuals use to place events into perspective. Constructs are defined by the interweaving of the past, present, and future; events give definition to constructs and constructs give meaning to events. The implication is that reflection on an experience, which in essence is anticipating the event, can result in a reconstruing of a construct. A significant aspect of the theory is that if individuals share common events in the development of their constructs, they will exhibit a similar set of psychological processes. This has significant meaning for learning by recognizing that it is possible for learners to arrive at a common core of knowledge; to do so requires that a compelling set of experiences be provided to make this common reconstruing of construct systems appealing to the individuals in a specific learning situations.

Adoue, Diane Sopko **Session 4.01** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Preparation for Teaching Science in a Professional Development School: Does Extended Field Experience Make a Difference?

This case study examined the extended field experience of student teachers who had previously been enrolled in a Professional Development School (PDS) cohort that required 15 hours of on-site course work in addition to their classroom assignment under the supervision of a mentor teacher. These students identified the elements in the PDS setting that (a) stood out as important while they were in the PDS cohort; (b) that enhanced or detracted from their developing construction of how to teach children; and (c) those elements in their on-site science methods class that enhanced or detracted from their developing construction of how to teach science to elementary children.

Akatugba, Ayo Harriet **Session 10.09** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency B

Mathematical Dimensions of Students' Use of Proportional Reasoning in High School Physics

John Wallace

This study examined the mathematical processes used by students when solving physics tasks requiring proportional reasoning. The study investigated students' understanding and explanations of their mathematical processes. A qualitative and interpretive case study was carried with six students from a co-educational urban high school for five months. The students solved some high school physics tasks requiring proportional reasoning during which a hermeneutic dialectic design was used to investigate their processes, understanding and difficulties. Research techniques such as dialogues, interviews, video and audio recordings were employed to generate, analyze and interpret data. Results of the study indicated that the students employed mathematical proportional reasoning patterns and algorithms which they could not explain. Students also had difficulties translating physics tasks into mathematical statements, symbols and relations. Students could not perform mathematical operations that were not directly obvious from the physics tasks while some had difficulty with division. Students did not seem to have adequate understanding of the mathematical processes involved in proportional reasoning. The study concludes with a discussion of the implications for teaching high school physics.

Aldridge, Jill **Session 6.02** **Saturday, March 22, 1997**
10:30am-12:00pm
Butterfield

Development of the Beliefs About Science and School Science Questionnaire BASSSQ

Peter Taylor

It is possible for two teachers to have a similar knowledge of science but teach in very different ways because, according to Nespor (1987), beliefs are more influential than knowledge as predictors of teacher behavior. The *Beliefs About Science and School Science Questionnaire* (BASSSQ) was developed to help identify a teacher's philosophical stance toward the nature of science and science teaching, with the aim of gaining greater insight into how teachers' beliefs about the nature of science affect their teaching practice. The conceptual development of the questionnaire was underpinned with a philosophical framework, and the questionnaire is designed to be used as a heuristic device that teacher-researchers can also use to reflect on their current practice. The conceptual strength, viability and validity of the questionnaire were demonstrated using a multiple perspective approach, including interviews, discussions, classroom observations and factor analysis.

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Allen, Nancy J. **Session 10.06** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook IV

Indigenous Models for Science-and-Culture Curriculum Development

The purpose of this study was to examine indigenous models for science/culture integration. The Four Directions Challenge in Technology Project brought together teams of teachers, administrators, community members, and students from thirteen Native American schools for a two-week institute in culture, technology, and curriculum development. Each team produced a multimedia project and classroom activities that incorporated science and culture within a thematic framework. Classroom discussions, journals, informal interviews, and curriculum products were used to determine what models were used by the teams and to determine effective ways to support local curriculum reform. Results indicated that although teams often shared areas of concern—and thus targeted similar science content—the models used for curriculum development differed according to community values on cultural instruction. Suggestions include providing communities with continued instruction in curriculum design strategies and encouraging local control of content.

Alters, Brian J. **Session 14.07** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency B

Relationships Between Acceptance or Rejection of Evolution by College Freshmen and Non-Religiously-Oriented Factors

William B. Michael

The primary purpose of this study was to investigate the extent of the relationship of acceptance or rejection of evolution by 649 freshmen at seven colleges and their (a) level of agreement with statements indicative of non-religious rationales for the rejection of evolution, (b) exposure to science, in general, and evolution education, in particular, (c) hierarchy of perceived authorities on human origins, and (d) views on selected science and society topics. Conclusions include: (a) Those freshmen who reject evolution in comparison with those who accept evolution hold significantly different conceptions that are indicative of non-religious rationales for rejecting evolution. (b) No differences exist among freshmen who reject evolution or who accept evolution with regard to amount of exposure to natural science courses, in general, and to the extent of academic exposure to evolution, in particular. (c) Approximately half of freshmen who accept evolution consider other sources, not evolutionary scientists, as most nearly accurate concerning human origins (e.g., the Bible). Moreover, approximately half of those who reject evolution find other sources, not the Bible, most nearly accurate. (d) Those freshmen who accept evolution in comparison with those who reject evolution tend to perceive greater objectivity and impartiality of scientists in carrying out and interpreting the results of research.

Anderson, Catherine **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Comparison of Teacher-Directed and Student-Directed Journals on Achievement in College Chemistry

The purpose of this study was to compare teacher directed (TD) and student directed (SD) written journals in introductory nonscience major college chemistry. Students in the both groups wrote two to four journal entries per week for a semester. Journals were collected weekly and randomly read by the researcher three times during the semester. Comments were made on student writing but spelling and grammar were not evaluated. The TD group wrote on specific questions or topics given by the instructor. The SD group wrote on anything they wanted to that pertained to chemistry. The 75 students in each of the two groups were compared for overall academic achievement and specifically achievement on conceptual problem solving and algorithmic problem solving. Students attitudes toward the study of chemistry and student attitudes to the usefulness of journal writing in chemistry were analyzed. The effect of student gender on these achievement and attitudinal findings was also studied. A quasi-experimental nonequivalent group design with pretest and posttest was utilized.

Andre, Thomas **Session 6.08** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook I

Science and Mathematics Versus Other School Subject Areas: Pupil Attitudes Versus Parent Attitudes

Myrna Whigham **Amy Hendrickson** **Sharon Chambers**

The purpose of this study was to compare the attitudes of elementary school pupils and their parents towards science, mathematics, and other school subjects. Attitudes influence student motivation and improving student attitudes toward science is a national educational goal. The data source were 400 pupils in grades K-6 and 351 parents. Participants completed surveys. Major results include: boys perceived themselves as more competent than girls in physical science, but not in mathematics, reading, or life science. The difference was greater for older (gr. 4-6) than younger students (k-3). Girls liked reading more and physical science less than did boys. Children saw physical science occupations as more male dominated. Parents and children perceived the child's abilities similarly. Parents rated subject matter importance the same regardless of sex of child, but male children rated subject matter importance much less than did female students. Additional results and the implications of these findings for educational practice were discussed.

Arambula-Greenfield, Teresa **Session 10.06** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook IV

A Female-friendly Model for Learning and Teaching Science

This project developed and implemented a "female-friendly" science program based on two sets of principles: the feminist pedagogical principles described in Belenky et al.'s "teacher as midwife" metaphor and the feminist science principles proposed by Rosser. The result was a problem-centered biology class that requires student teams to individually investigate various, interdisciplinary dimensions of selected health-related problems and to collaboratively formulate a response to the problem based on group analysis and integration of data. Quantitative and qualitative evaluation data indicate that this approach appeals not only to the traditional white male science student but also particularly to female students, who indicate significant gains in both attitude towards and knowledge of science. Such gains are essential both for enhancing the success of females in science and for investigating and ultimately altering the masculine nature of science to make it more "female friendly."

Atwater, Mary M. **Session 14.04** **Sunday, March 23, 1997**
4:00pm-5:00pm
Spring Room

A Continuing Saga: Journeys in Multiculturalism

Denise Crockett **Tonjua Freeman**

The purpose of this multiple case study was to determine if any changes had occurred in cultural development, development of ways of knowing science, and science teaching development of two preservice teachers during their teaching experience. This study used both the guided approach and an open-ended interview format. Analytic induction was the approach utilized in this study for both data collection and data analysis. The final interviews occurred after Ray's student teaching experience and during Amy's first year of teaching. Interviews were transcribed and analyzed. The contextual analysis of the interviews consisted of line by line analysis of the transcriptions. Findings included the following: (1) the pace of teachers' multicultural journey is affected by the cultural diversity of their students and the cultural richness of their schools and (2) a change in one dimension does not guarantee a change in the other two dimensions.

Ballas, Jacqua **Session 12.06** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook I

Teachers' Immersion in Authentic Scientific Research

Terri Kielborn

Two middle school teachers conducted a mapping study of cogongrass population at a state park in Florida. This experience provided the rare opportunity for teachers to participate in authentic field research. Cogongrass is of interest because it disrupts normal fire ecology in the pristine sandhill community, making it impossible for native grasses to survive. The goal of the project is to reduce the amount of cogongrass in the park by 80% and restore the sandhill to its natural state. The teachers mapped the park by determining the density of cogongrass by ocular estimation, using a quadrant system to locate and map each section. The regions densest in cogongrass will be treated with herbicide in the fall, followed by remapping in the following spring. Native grasses will be planted in the next summer. The teachers learned a number of applications about scientific research: the importance of teamwork and of keeping a detailed scientific notebook; the impact of exotic species on natural systems; and calculations, such as unit conversions and rounding of numbers. The teachers plan to have their own students map cogongrass on properties that are near the school. The students will learn the process of science by conducting research similarly to how the teachers learned.

Barden, Laura **Session 17.06** **Monday, March 24, 1997**
10:30am-12:00pm
Oak Brook III

Strategies Exhibited by High School Biology Students During Laboratories

The development of students' strategies for solving problems have seldom been examined beyond comparisons of novices and experts, particularly in a social setting such as the school laboratory. This study was designed to investigate the types and development of strategies exhibited by students during laboratory activities. Subjects included 27 high school students enrolled in one of two sections of introductory biology. Several types of data were collected for each subject. First, lab groups were observed during lab sessions—conversations between lab partners were audiotaped and their corresponding activities were noted. Prior to each lab session, the order of observation was randomly determined. Second, six subjects participated in a semi-structured interview. The interviews were designed to focus on subjects' strategy use during lab and their level of understanding of lab content. Third, all subjects submitted responses to lab questions and lab reports. Finally, at the end of the academic year, all subjects completed a survey concerning their perceptions of lab. Four distinct types of strategies were identified: (a) social-interaction strategies, (b) task-completion strategies, (c) cognitive strategies, and (d) conflict-resolution strategies. The type of lab performed (traditional vs. open-ended) influenced the frequency of types of strategies used.

Barker, Brett A. **Session 13.09** **Sunday, March 23, 1997**
2:30pm-3:30pm
York 1,2,3

Modifying the Learning Cycle Model to Enhance Students' Construction of Science Content, Concepts and Conceptions

Robert J. Stahl

This paper reports an investigation of the assumptions underlying and the effectiveness of the Learning Cycle model (LCM) of instruction (Lawson, Abraham, & Renner, 1989) in light of its multiple goals, interprets the research findings and claims for this model, and proposes an alternative model linked directly to a new set of concepts and principles of cognitive psychology and constructivism that will enhance student content and conceptual learning in science classrooms. The Information-Constructivist perspective is used to complement the theoretical basis of the LCM and specific additions and revisions are made in light of this perspective and its applications to curriculum, instruction and assessment. Strengths and weaknesses of the current LCM are reported along with specific statements to build on the strengths and rectify the weaknesses. Strengths and advantages of the new model are emphasized along with guidelines for teachers and students prior to, during and following a lesson using this model. Classroom examples of the new LCM are provided along with results of a small pilot study of the application of this model with a small sample of students.

Barnea, Nitza **Session 9.04** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook II

The Effect of Using Computerized Molecular Modeling on High School Chemistry Students' Performance

Yehudit J. Dori

The advantage of computerized molecular modeling (CMM) to illustrate and explore phenomena in chemistry teaching stems from the convenience and simplicity of building molecules of any size and color in a number of presentations. A new methodology that is based on using CMM with a working booklet, designed in a constructivist approach, was implemented during 1995. Three tenth grade- experimental classes used the new methodology and two other classes who studied the same topic in the customary approach served as a control group. The effect of using molecular modeling on students' spatial ability and understanding of new concepts related to geometric and symbolic representations was investigated. Students from the experimental group improved their spatial ability and 3-D understanding of molecular structure to a higher extent than those of the control group. Most of the students enjoyed using the new methodology, and indicated it helped them understand concepts in molecular geometry and bonding. The results of this study suggest that topics in chemistry that are related to three dimensional structure can be taught in a constructivist approach where students are actively involved in the learning process while using a computerized environment.

Barnett, John **Session 9.08** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

What Makes Successful Science Education Projects: The Problematics of Teacher Input

The author has been directly connected with two Canadian science education projects widely seen as successful. The Atlantic Science Curriculum Project Incorporated (ASCPI) is a major curriculum developer of middle school science materials in North America while the Assessment of Science and Technology Achievement Project (ASTAP) is writing science education standards and assessment instruments for school boards and government in Ontario, Canada. Although the projects differ in scope, aims, structures, and products, they have in common a commitment to working with teachers, listening to them, and respecting their advice. This approach, however, raises inevitable theoretical, practical, and procedural difficulties. This paper will examine the commonalities, differences, and problematics of the approaches taken in the areas of teachers' input, control over products/processes, and relationship between teachers' knowledge and educational theory. The discussion will help to better elucidate useful strategies involved in working cooperatively with science teachers.

Bartley, Anthony **Session 6.07** **Saturday, March 22, 1997**
10:30am-12:00pm
Kent 1,2,3

A Model for Describing Performance Assessment Tasks

The expansion of the use of performance assessment in science has led to increasing emphasis upon the need for extensive validation studies. This study addresses two important validity issues: individual item description and content representation. The paper starts with an examination of the assessment frameworks used in a number of large-scale science assessments. A model for the description of performance assessment tasks is proposed and applied. This model consists of a relational diagram which enables the attributes, content and practical skills (Millar, 1991) to be mapped out. The use of the model is demonstrated for individual tasks and the complete set of performance items in an assessment. The study concludes with a critique of the use of a generalizability theory and in this context and proposes an approach that would integrate the model proposed here with statistical approaches.

Barton, Angela Calabrese **Session 17.13** **Monday, March 24, 1997**
8:30am-10:00am
Regency D

Liberatory Science Education: Rethinking Pedagogical Practice from Feminist Perspectives

Margery D. Osborne **Sherry Nichols** **Deborah Tippins** **Constanza Hazelwood**
Lynne Cavazos **Matthew Weinstein** **Elaine Howes**

There has been much conversation in the years since Paulo Freire's *Pedagogy of the Oppressed* was first published concerning issues of "culturally relevant teaching," "liberatory and democratic education," "critical educational practices" and "developing critical consciousness." What has been missing from much of these conversations is the sense of what such an education might look like in teaching children science. All of the phrases listed suggest important issues to consider when practitioners attempt to construct education with children that is equitable, enhancing, and empowering. We would like to continue this conversation from another perspective by crafting an interactive symposium which looks closely at the notion of liberatory and democratic education, as defined in the works of feminist in the context of K-12 science education and preservice science teacher education. This interactive session will focus on the questions are: What are the meanings of the notions "liberatory" and "democratic education" within different areas of science education (K-12 science education and science teacher education)? The constructs that we will use to focus the conversations are ideas of science, the place of science critique in children's education, and the question of what constitutes liberatory practice for children in schools.

Bauer, Christopher F. **Session 12.08** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook III

College Students' Post-Hoc Attitudes Toward and Descriptions of Their High School Learning Environments

More than one hundred first-year college chemistry students provided a detailed retrospective of the learning environment in their high school chemistry courses. Attitudes were assessed with an NAEP-like attitude inventory containing questions pertinent to the class, the utility of the subject matter, and the teacher. Learning environments were described by specifying on a checklist how often particular instructional methods, such as lab experiments, lectures, and discussions, were encountered. Five classroom profiles were delineated by cluster analysis and attitude scores were averaged within each profile. A strong positive correlation was found between attitudes and the frequency of occurrence of student-centered active-learning instructional methods. The most positive attitudes were found in classrooms with the most diverse learning activities. Thematic analysis of written student comments confirmed the attitude survey results.

Baumgartner, Eric **Session 17.06** **Monday, March 24, 1997**
10:30am-12:00pm
Oak Brook III

Inquiry Through Design: Situating and Supporting Inquiry through Design Projects in High School Science Classes

Brian J. Reiser

This paper describes a model for supporting scientific inquiry situated within a technological design context. This model is the basis for the design of several modules intended for use in high school science classrooms. A study of the classroom use of one module by two different teachers examined the degree to which module activities allowed students to engage in the processes of inquiry. Results, based on classroom observations, videotape analyses, and interviews with students and teachers, suggest that the design context was successful in fostering the key components of scientific inquiry, including question generation, the development of investigations to pursue questions, and the improvement of students' designs over time based upon their empirical results.

Bayrhuber, Horst **Session 3.07** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook II

Students' preconceptions of Bacteria and the Consequences

Sabine Stolte

The popular belief that students would mainly equate bacteria with pathogens has not been confirmed. On the contrary, our survey showed that students are indeed able to differentiate between useful and harmful bacteria. However, they did not seem to be aware of the fact that most kinds of bacteria do not have an immediate effect on humans, neither in a positive nor in a negative respect; but that they do play a central role in the biosphere. In the students' preconceptions, bacteria are grouped with unicellular eucaryotes to form a big group of microscopically small creatures. In its dimensions this grouping corresponds more or less with the group of "microorganisms of biologists. However, students do not differentiate between procaryotes, eucaryotes and even viruses and suppose that all of them have a similar structure. An important conclusion for teaching is the suggestion of a comparing investigation of micro-organisms when introducing bacteria in class. In terms of content the conception of bacteria as decomposers should be furthered since this was frequently mentioned in connection with digestion as well as with the production and disposal of food stuffs. Considering the numerous other functions of bacteria in the biosphere, this conception should be enlarged on. Misconceptions in regard to bacterial activity in the human stomach and intestines should be corrected.

Bell, Jerry A. **Session 17.07** **Monday, March 24, 1997**
10:30am-12:00pm
Regency A

Designing an Environmental Science-Based Professional Development Program to Affect Change in Middle School Teacher Teams

Project Alliance, a two-year education program for interdisciplinary teams of middle school teachers, is designed to (1) increase teacher knowledge of environmental science and computer technologies as well as pedagogical content, (2) have teacher teams produce, pilot, and refine curriculum units that integrate science, mathematics, technology, and other disciplines with appropriate teaching and assessment strategies, and (3) enable teachers disseminate to other educators the process for developing an integrated curriculum and team approach to teaching. Teams are supported by scientist/engineer partners and school administrators during each phase of the program. At the heart of the goals of the project is the concept of teacher teams. Teachers work together and share their expertise to enhance student learning through integrated curricula and in turn become leaders who help other educators to undertake this approach to teaching and learning.

Bell, Phillip **Session 6.13** **Saturday, March 22, 1997**
10:30am-12:00pm
York 1,2,3

Using Technology to Support Conceptual Change In Science: Helping Students Learn about light using the Internet

Marcia C. Linn

In many ways, fast-paced developments in technology have outpaced basic research into its application to science instruction. Continuing efforts are ongoing which attempt to coordinate new technological capabilities with evolving theories of learning and instruction. Using results of classroom research from the past decade, we report on a developing instructional framework called Scaffolded Knowledge Integration (SKI) which addresses this issue. The SKI framework emphasizes: (a) specific goals for instruction where "less is more" and students are encouraged to connect their scientific ideas to their own life experiences; (b) autonomy of students as they conduct their investigations and critiques; (c) making scientific thinking visible to students, and (d) providing social supports during instruction so that students benefit from being actively involved in the classroom setting. During this session, we will focus on recent research involving the design of instruction to promote students' conceptual change on concepts of light. The instruction was implemented within the Knowledge Integration Environment (KIE) that we have been developing which focuses student activity around complex scientific evidence found on the Internet. We will discuss the benefits and challenges involved with having students build scientific arguments around competing theories and thereby refining their conceptual understanding about light.

BEST COPY AVAILABLE

Berlin, Donna F. **Session 7.12** **Saturday, March 22, 1997**
12:00pm-1:00pm
York 1,2,3

Construction and Validation of an Instrument to Measure Understanding of Pattern by Elementary School Students

The purpose of this study was to construct and validate an instrument to measure spatial and symbolic processing of patterns by elementary school students. The ability to understand, relate, and translate patterns presented in different representational modes plays a prominent role in the development of scientific and mathematical literacy. The Spatial-Symbolic Pattern Instrument was designed to measure student's recognition, application, and understanding of patterns, defined qualitatively or quantitatively. This study advances the results of previous analyses of the instrument. A principal components analysis of 186 fourth and fifth graders' responses to a 57- item instrument revealed three factors labeled as Figural Pattern (15 items), Numeric Pattern (8 items), and Word Pattern (5 items). Internal consistency reliability coefficients for each of the three scales are 0.85, 0.80. and 0.95, respectively. Statistical analyses conducted on each of the scales suggest a grade level difference for the Figural Pattern Scale but no gender differences. Results indicate that this is a reliable and valid instrument to explore student understanding of patterns as presented through different representational modes.

Bielenberg, Joy E. **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Learning from Practice: Impressions from Pictures of Scientists Don't Tell the Whole Story

The purpose of this study was to determine the prior knowledge of students regarding scientists and their work. Students' depictions of scientists in pictures were compared to their responses in agreement or disagreement to statements about scientists and their work. The 124 seventh grade students drew a picture of a scientist and then told why they agreed or disagreed with statements such as, "Science is a job for men." Pictures were analyzed using the stereotypic features attributed to scientists as reported in earlier studies: gender, lab coat, eyeglasses, hair, and symbols of research. Categories of students' responses to the statements emerged from the data. For example, the categories for students' disagreement with the statement, "Science is a job for men," ranked in order of times utilized by students were: women are capable, women are smart, science is a job for everyone, men and women have equal rights, and women are scientists. Results indicated that caution should be used when interpreting the pictures students draw of scientists. Written responses indicated that students had a more realistic view of scientists and their work than the stereotypic images drawn by the students indicated.

Bird, Mary Dickinson **Session 16.02** **Monday, March 24, 1997**
8:30am-10:00am
Kent 1,2,3

Cultures in Conflict: The Role of Teacher Knowledge in Inquiry Science Lessons

Herman G. Weller

In his 1990 analysis of a framework for understanding classroom knowledge and practice, Walter Doyle elaborates on two images of teaching. The first, externally derived from an effectiveness perspective, characterizes teaching as "a process of representing and enacting curriculum in the complex environment of the classroom." The second is a cognitive, constructivist view that teaching is "event-structured," a form of problem-solving that is based on "case knowledge" of individual students or groups of students in a specific learning environment. In either case, the development of teachers' understanding of, and confidence in, their practice seems to be centered around predictable relationships between the nature of a specific classroom activity, the expectations of the students, and the perceived responsibility of the teacher. Research conducted with a small group of elementary teachers attempting to implement genuine science inquiry in their classrooms demonstrated that the unpredictability of events, together with unanticipated nature of content and novel activity formats shook the foundations of teachers' classroom knowledge. Bereft of their curricular structure and devoid of "case knowledge" for authentic inquiry, these teachers struggled, with mixed success, to create new and acceptable conceptions of classroom knowledge and practice.

Bisard, Walter **Session 9.03** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook I

Results of Utilizing a Research-based Conceptual Course Development Model For a Large Enrollment Astronomy Class

The purpose of this study was to investigate the effects of a research-based conceptual course development model in the instruction, learning, and assessment of a university-level introductory astronomy course. The model of course development was designed by a team of astronomers, science educators, and educational psychologists at the University of New Mexico and Central Michigan University. The model identified the major concepts necessary for a connected understanding of astronomy and its development encompassed the creation of several instructional and assessment instruments. The astronomy course consisted of two sections with the same professor and equivalent objectives, concepts, and tests with a total enrollment of over 300 students. One section utilized a traditional approach of lecture and audio-visual support while the other section utilized several innovative instructional strategies such as dedicated cooperative teams, guided interactions and discussions, concept mapping, and generic homework assignments. Assessment instruments included multiple choice tests, pre/post measures of difficult concepts, concept relatedness ratings, and concept maps.

Black, Dana Riley **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Visitors' Apparent Need for Direction When Learning Science at a Museum of Natural History

The purpose of this study was to explore what students believe they are learning about science and scientists during a field trip visit to a museum of natural history. Following techniques of grounded theory, the study was initiated with the development of a student survey. Seventy-seven surveys sets were sent to fourth, fifth, and/or sixth grade teachers who were scheduled to bring their class to the museum. A total of 942 surveys were returned. The surveys were followed-up with:18 interviews of students who had visited the museum with a school group. Both surveys and interviews indicated that students were most comfortable learning science at the museum when they were in situations directed by someone or something other than themselves. The implications discussed include the design of text-based exhibit labels and the need for research regarding exhibits without text labels or the direct influence of museum staff members.

Black, Kathie **Session 12.12** **Sunday, March 23, 1997**
10:30am-12:00pm
York 1,2,3

Science Content Courses for Pre-Service Teachers: A Balancing Act of Teaching/Learning Strategies

Inquiry-based constructivist practices that include innovative teaching and learning strategies are at the fore-front of science education internationally. Examination of these strategies has guided on-going research in curriculum design for university Earth Science content courses (Black, 1994, 1995, 1996a). However, despite positive results from previous segments of this research, an effective balance between traditional and innovative teaching and learning strategies has not been achieved. This study examined results of curriculum designed to balance traditional versus innovative teaching strategies in Earth Science content courses for pre-service teachers. Considering earlier empirical findings (Black, 1996a), it was expected that participants receiving this instruction would receive higher science comprehension scores than earlier sections. Furthermore, it was expected that these students would report higher perceptions of the course than students from previous semesters. Significance was demonstrated among overall group participant pre and post science comprehension scores, $F(3,92) = 10.5045$, $p < .001$. Between groups' science content scores, story presentation scores, written story scores, and overall final marks were significant, $F(3,92) = 8.154$, $p < .001$. Student perceptions regarding the course also improved significantly.

Blakely, Alan **Session 12.07** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook II

Effects of a First-Year Chemistry Laboratory Program Requiring Students to Develop Their Own Experiments

This investigation was designed as a control-treatment quasi-experimental study to explore the effects of changing the type of chemistry laboratory instruction for first-year university students. The control group received explicit instructions under the traditional "recipe" model. The treatment group received instructions that required them to develop their ability to design their own laboratory procedures. Differences in achievement on both standardized and researcher-designed tests were observed, but these differences were not statistically significant. This indicates that the students in the treatment group were able to reach the same level of achievement as the students in the control group, but under more challenging conditions.

Bleicher, Robert E. **Session 17.06** **Monday, March 24, 1997**
10:30am-12:00pm
Oak Brook III

Scientists as Mentors to Students in Research Laboratories

This research posits that high school students' participation in research workplace apprenticeships leads to changes in their beliefs about the nature of science which add new dimensions to their enthusiasm for and success in learning science. The study covered three consecutive years of a summer science program at a California university. Data included ethnographic fieldnotes, interviews, and videotaped laboratory interactions. Analysis focused on discourse between scientist-mentors and high school student apprentices in research laboratories. How the scientist-mentors viewed, evaluated, and enjoyed working with their student-apprentices had a large effect upon student learning. Students demonstrated increased conceptual understanding of specific science topics. Since students returned to their schools after their apprenticeships, there was the potential to employ them as change agents within their cadre of fellow schoolmates. There is presently no program or research base for exploring this potentially valuable avenue to school science reform. This paper provides a list of "desirable" mentor characteristics that led to successful mentor-student interactions. 2-24

Bleicher, Robert E. **Session 9.14** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency D

Opportunities to Talk Science in the Classroom.

Campbell J. McRobbie **Kenneth Tobin**

The purpose of this study was to develop a better understanding of the discourse strategies employed by students and the teacher as they engaged in various activities in the classroom. More specifically, it examined how discourse supports or constrains opportunities to engage in experimentation and making sense of new experiences, what Lemke called "talking science". Data, collected daily for four weeks in a high school chemistry classroom, included ethnographic fieldnotes, video recordings, and interview transcripts. Discourse analysis was triangulated with other data to produce a rich description of the classroom. It was found that the teacher maintained complete control of the discourse which was consistent with both his and his students' expectations and aims. The paper suggests possible interventions in the situation that could result in students having more opportunity to talk science. The significance of this research is based on the understanding of the micro-discourse strategies that contributed to issues of control of talk and activities by the teacher in the classroom and the implications of this to constructivist approaches to learning.

Bodner, George **Session 3.06** **Friday, March 21, 1997**
7:00pm-8:30pm
Kent 1,2,3

Reconciling the Theory of a Constructivist Computer-based Learning Environment with the Constraints of Personal Computers

Dorit Maor

This paper is part of an on-going study of the conflict between an individual's convictions or beliefs about what they want to achieve in their classroom and the technical, bureaucratic, and personal constraints that interfere with their reaching these goals. The particular context of this study is an attempt to create an interactive, multimedia computerized database program that would help students develop higher-order or critical thinking skills within a constructivist environment. The study examines the extent to which the original goals of the program were achieved, the relative ease with which various goals were reached, the limits on achieving these goals presented by the state-of-the-art in computers for instruction, the "traps" into which software developers can fall while struggling to achieve their goals, and implications for the use of computer-based instruction programs within the framework of a constructivist classroom environment.

Boegeholz, Susanne **Session 14.07** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency B

The Impact of Nature Experience on Environmental Action

Jürgen Mayer

In this study direct nature experience is investigated for its influence on environmental knowledge as well as the formation of motives and intentions of environmental behavior in children and adolescents. The theoretic construct "nature experience" focuses on five dimensions: scientific, ecological, utilitarian, social and aesthetic. These are particularly relevant to the instruction of environmental education. Three classes ("low", "middle", "high") of nature experience were crystallized by using Latent Class Analysis. The hypothesis: "If nature experiences are more abundant, then environmental activities will be more likely" has been investigated by putting a theory of the integrated model of action to the test. According to the hypothesis the results indicate a certain impact from nature experience on environmental knowledge and environmental action depending on the different class-memberships. Findings will provide insight into the extent to which nature experience can be effectively incorporated into educational knowledge and positive environmental activities.

Bolick, Margaret **Session 12.04** **Sunday, March 23, 1997**
10:30am-12:00pm
Hunt 1,2,3

Socialization Influences on a Beginning Teacher Prepared as a Constructivist Educator

Emmett L. Wright

This case study created a holistic picture within the elementary school environment of a beginning teacher prepared in a restructured, constructivist-based undergraduate teacher education program which focused on science, mathematics, and technology. The researcher served as participant observer in the sixth grade classroom of a second year teacher in a rural midwestern school. The picture, illustrated through the eyes of the students, parents, teachers, the beginning teacher, and the researcher, was constructed and interpreted from field notes, interviews, videotapes, and journals. Biography, time, and the restructured teacher education program influenced the teaching of the beginning teacher, who struggled to create a balance between traditional teaching experienced as a student and the teaching modeled in her preservice program. Traditional teachers and a traditional school environment reinforced her biography. The beginning teacher teaches from a constructivist perspective in science and mathematics but resorts to traditional methods when teaching other subjects. The researchers conclude teachers who experience restructured, constructivist-based teacher education programs will continue to struggle with socialization into the culture of schools until they are taught in restructured schools and enter restructured schools to teach.

Boone, William J. **Session 9.10** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency B

Race, Gender, Test Length, and Missing Data. Why Estimates of Performance may be Clouded.

Steven R. Rogg Jane Butler Kahle Arta Damnjanovic

In 1991, Ohio received NSF funding through its SSI program. One aspect of the reform effort involved evaluating the performance of middle school students with a test item bank of NAEP items. This paper presents the results of evaluating these data. Specifically, how unanswered items can/can not effect analysis of such data when it is used to calculate mean performance measures of groups. How "missing" data can influence calculations of group performance (e.g., females vs. males) is significant for if particular subgroups do not complete a test in much higher numbers than other subgroups it is likely that analyzed data may not reflect reality. If missing data does influence calculation of subgroup science performance, what are the implications with regard to the analysis and the construction of science tests? Analyzed data show a great disparity in the percentage of blacks and whites answering the science tests items. Noteworthy are black and white students' answering (and not answering) patterns toward the end of the science test. At the end of the test the disparity between blacks and whites attempting items increases significantly. Male and female test takers exhibit some of the same trends as observed in the racial comparison.

Bowen, Craig W. **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Results of a National Survey on Assessment-of-Student-Learning Practices in College Chemistry

Rosalind Slavings Noal Cochran

Assessment of student learning is an essential component of the curriculum. A national survey was conducted to determine how student learning is being measured at the college level. Two populations were targeted and randomly sampled from: chemistry departments with Committee on Professional Training (CPT) approved programs, and chemistry departments with Course and Curriculum Development (CCD) projects underway in chemistry. Surveys were sent to 285 CPT approved programs and 44 CCD institutions. Faculty teaching general, organic, physical, and advanced chemistry responded to the survey which contained six areas related to assessment: Course Structure and Institutional Demographics, Assessment of Various Learning Outcomes, Techniques of Assessment, Administrative Aspects of Measuring Student Learning, Role of Assessment in the Curriculum, and Changes in Assessment. The paper provides a summary of responses in these six areas as a function of course being taught and other institutional demographics. For example, results showed that the most valued learning outcomes are development of conceptual understanding and reasoning skills across all areas of chemistry, while the least valued are development of social skills and self-reliance.

Bowen, Michael G. **Session 7.08** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency C

Appropriation of Graphical Representation Practices in Small Group Interactions

Wolff-Michael Roth Michelle McGinn

Producing and interpreting graphs is a central practice in the scientific community, and learning this practice is an important aspect of moving from being a biology student to becoming a biology researcher. This study was designed to help us better understand the ways college students learn to interpret graphs. Particular attention is paid to interactions between students and the resources they used to make their interpretations. Student discussions of problem sets assigned in an undergraduate ecology seminar were videotaped and transcribed. Resources used by the students included prior discourses developed in biology and mathematics, comments remembered from lecture, readings of problems and instructions, and questions directed to the teaching assistant. To interpret graphs, students used resources that we conceptualized as ranging from "direct" to "near-indirect" to "far-indirect" indicating the degree of conceptual relationship to the problem being addressed. These resources both helped and hindered students as they interpreted graphs and their relation to ecology 'in the field.' We conjecture that more opportunities for small groups of students to discuss the use of different resources in interpreting graphs would assist them in developing graphing-related competencies that exceed those which they presently attain.

Brand, Brenda R. **Session 6.12** **Saturday, March 22, 1997**
10:30am-12:00pm
Windsor

Minority Perspectives of Teaching and Learning in Science Education

George E. Glasson

Theories regarding multicultural education in science classes suggest that minority students may be considered outsiders to the subculture of "school science." These students may cross cultural borders into science classrooms that are alien and void of their experiences. As a result, some minorities find it difficult to adjust and be successful. Using the voices of minority students, this research was designed to substantiate and further explore theoretical claims of the barriers that minorities face when crossing borders into the subculture of school science. The participants in this study were eight African-American high school and undergraduate students, along with the director and a counselor. These individuals were involved in a program designed to increase the number of minority teachers in science classes. The participants were asked a series of questions about their experiences in science classes and their concerns, needs and preferences. The data from these interviews were interpreted and organized into themes based on the perspective of students as outsiders crossing cultural borders. These findings document participants discussing their views and experiences in science classrooms, and how these experiences influence students' learning. Very evident within these discussions are the importance of student-teacher relationships to minority students' success.

Brand, Catherine **Session 8.11** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency E

Models Children Build: Content, Logic, and Educational Impact

Heidi Carlone **Clayton Lewis** **Cyndi Rader**

Twenty-seven fourth and fifth grade students, working in groups of up to three children, created animated, graphical computer models of processes and phenomena related to skin color and associated topics. About half of the 16 models had explanatory content, with the remainder being illustrations of facts or processes. The models used a variety of ways of representing content, including explicit representation of causal relationships and detailed rendition of scenarios. Model building appeared to provide a useful framework for study, but did not have a profound effect on children's understanding. More emphasis on critical evaluation of models may lead to greater impact.

Brewer, Steven D. **Session 12.10** **Sunday, March 23, 1997**
10:30am-12:00pm
Ogden

A Model of Desired Performance in Phylogenetic Tree Construction for Teaching Evolution

The purpose of this research was to begin the creation of a knowledge base that could guide the development of instructional materials and curricula for the teaching of systematics and evolutionary biology. Nine expert phylogenetic systematists participated in the research project by thinking aloud while constructing phylogenetic trees to account for each of a series of problem data matrices. Analysis of the think-aloud protocols resulted in a model of expert performance. The expert model and a rational analysis of phylogenetic tree construction were used to construct a model of desired student performance. The model of desired performance, the model of expert performance, and descriptions of associated strategies and heuristics should all be directly applicable to the development of curricula for teaching phylogenetic tree construction.

Briscoe, Carol **Session 7.10** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency E

Teaching Biology to Prospective Elementary Teachers: Evolution of an Instructor's Classroom Interactions

Ann Lumsden

This collaborative study focuses on communicative interactions that a college biology instructor fostered in the context of teaching an introductory course designed for elementary education majors. Interpretations from this study illuminate social and individual factors that constrained the teacher's interactions. We also describe how the instructor, through reflection on her practices, overcame these constraints, and over time, changed the curriculum in ways that increased students' engagement in discussion of science concepts. The study clarifies the role of university instructors in orchestrating discourse about scientific ideas, as recommended in the National Science Education Standards, rather than continuing to use traditional lecture coupled with occasional questioning as the primary form of university instruction.

Brown, David **Session 7.09** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency F

Constructive Lenses for Viewing and Valuing Student's Activities During Inquiry in Science

Diana Beck **Richard Frazier**

From a constructivist perspective, inquiry provides a context for students to test and refine their ideas via physical interaction with the materials and articulation of their ideas with others. While this is an ideal, what actually happens during inquiry activities in which students are given some autonomy in their explorations? In video analyses of four segments of students engaged in inquiry activities at a summer science camp, what emerges is neither the romantics' vision of fully engaged students deeply studying the mysteries of nature nor the skeptics' vision of students "just playing around." Rather what begins to emerge are rich pictures of real students in complex contexts, which raise fundamental issues about science teaching and learning. Through interpretive analyses of the videotapes, several important, previously undocumented aspects of contexts of inquiry have emerged. While many educators undoubtedly consider such perspectives in an intuitive way, articulating these constructs explicitly can help researchers, teachers and curriculum designers to use the perspectives more efficiently in their research, planning, teaching, and reflection.

Brown, Fletcher **Session 12.03** **Sunday, March 23, 1997**
10:30am-12:00pm
Harger

Characterizing Effective Environmental Education and Its Impact on Students' Environmental Activities

The purpose of this study was to measure change in students' environmental attitudes and defensibility after taking a course modeling effective environmental education. For three different semesters preservice elementary education students taking an environmental science course which modeled national recommendations in environmental and science education were given the actual form of the Science Laboratory Environment Inventory (SLEI) and the Environmental Issues Attitudes Defensibility Inventory (EIADI). Mean scores for the five scales of the SLEI questionnaire provided a unique learning environment profile which can be used to help clarify what characterizes an exemplar environmental education classroom. Pre and post scores were analyzed for any significant change for the EIADI data. Results show positive short-term changes in students' attitudes and defensibility after exposure to the learning environment studied.

Burrmann, Ulrike **Session 16.05** **Monday, March 24, 1997**
8:30am-10:00am
Regency B

Learning Strategies, Motivation and Case Teaching

Instruments have been developed to tap students' preferences and motivation with respect to science and other subjects, and to establish what learning strategies they employ in four domains (learning by listening, solving difficult problems, memorising, and learning with others) and four dimensions (superficial, deep structure, use of aids, and metacognitive). The two questionnaires were given to 100 7th grade students in Potsdam, and 600 grade 6 and grade 7 students from CASE and non-CASE schools in London. Results of many comparisons between German and English students, and between CASE and non-CASE students will be presented. There were significant differences in the interest of German and English students in different subjects; there was the same diminution of learning motivation from grade 6 to grade 7 in CASE classes as in non-CASE classes; German students seemed to be less motivated by the desire to impress teachers and parents than were English students; against expectations, 7th grade non-CASE students claimed to use more metacognitive learning strategies than CASE students. Although grade 6 CASE students seem to use deep structure strategies more than other groups, grade 7 CASE students use them less.

Burry-Stock, Judith A. **Session 8.13** **Saturday, March 22, 1997**
1:00pm-2:30pm
York 1,2,3

Voices of Reform: The Project Evaluator

Programs designed to bring about systemic reform need a program evaluation component that involves formative feedback. Program evaluators need to be familiar with the project and very sensitive to participant and staff needs. This discussion will address this model for evaluation. Feedback is provided through adaptations of traditional evaluation techniques and the use of performance assessment rubrics. The annual evaluation report includes: Program surveys, student attitude and achievement data, teaching practices, self-report, and observation data. Built into the program evaluation is an extensive research design on systemic reform. This project's main emphasis is on enhancing science teachers' performance and student conceptual understanding. Theory, applications, and results will be discussed.

Burry-Stock, Judith A. **Session 10.04** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook I

Expert Science Teaching: A Russian American Comparison

The Expert Science Teaching Educational Evaluation Model (ESTEEM) was developed to enhance professional development in science teaching. It was a US Office of Educational Research and Improvement (OERI) project supported by the Center for Educational Research on Educational Accountability and Teacher Evaluation (CREATE). It was developed according to a combination of a constructivist and expert teaching philosophy, houses six instruments, and matches the professional development section of the new National Science Education Standards. ESTEEM has been used in about 15 million dollars of grants and has been translated into Russian. The Russian educational system is different from the US; however, the Russians are also interested in constructivist science teaching. Russian data on eight teachers were collected during a one-month visit to Voronezh, Russia funded by the National Research Council. These data have been compared with two random samples of American teachers. An Analysis of Variance with the three groups on the Science Classroom Observation Rubric from ESTEEM revealed statistically significant differences for three out of four categories and the total score of the observation rubric. Other qualitative and quantitative differences exist on teacher training, class scheduling, teacher attitudes, and student attitudes.

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Burry-Stock, Judith A. **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

Using ESTEEM, How Long Does It Take to Become an Expert Constructivist Science Teacher?

Robert Yager **Gary Varrella**

The Expert Science Teaching Educational Evaluation Model (ESTEEM) was developed to evaluate expert science teaching according to a combination of a constructivist and expert teaching philosophy. This perspective provides a sound theoretical basis for teaching and learning behaviors focusing on student-centered teaching that promotes meaningful, conceptual learning. ESTEEM is a professional development model to be administered by oneself, a peer, or an external evaluator. It houses five instruments designed to assess expert science teaching for both teaching practices and student outcomes and is currently being used for evaluating expert science teaching in many national and international projects. The Teaching Practice Inventory (TPI) is a self-report instrument on teaching practices from ESTEEM. Data from the University of Iowa's Scope Sequence and Coordination (SS&C) project reveal that means go up steadily on six subscales and the total test score the longer teachers are involved in a reform project such as SS&C. Using the ESTEEM scoring system (Burry-Stock, 1995b) of novice, advanced beginner, competent, proficient, expert, teachers who have been involved three to five years rank themselves proficient. Teachers below three years rank themselves competent. In working with traditional teachers who participate in a constructivist reform effort, factors such as context, degree of support, characteristics of the project, and type of institution in which the teacher is working become critical factors in answering the question, how long does it take to become a constructivist teacher? Other ESTEEM instruments measure different aspects of constructivist teaching and the novice through expert classification varies from instrument to instrument.

Buttles, H. Sunny **Session 13.01** **Sunday, March 23, 1997**
2:30pm-3:30pm
Butterfield

Group Impact on Individual Problem Solving within the Undergraduate Genetics Course

Duane F. Shell

This paper describes research designed to isolate evidence for group influence on individual behavior in an undergraduate class studying prototypical inheritance patterns through experimentation with computer simulations of breeding experiments. The data consisted of (a) verbal protocols concurrently produced during solution of 2 problems by 17 undergraduate biology majors, (b) records of problem solving success, (c) individual test results before and after the group work, and (d) summative interviews probing student interpretation of group learning. Results indicated that, regardless of student perception of the utility of group work for fostering learning, 2 other factors were the primary determinants of teacher-defined success: (a) well-integrated prior knowledge of the domain which was highly dependent on the learner's goal orientation and epistemological beliefs, and (b) prior experience with real or quasi-authentic research problems. Additionally, the interviews revealed that the opportunity for positive interaction during group work was inhibited by situations in which the group felt there was membership inequality due to overly large knowledge stratification in either prior knowledge of the domain or problem solving experience.

Butts, David P. **Session 3.11** **Friday, March 21, 1997**
7:00pm-8:30pm
York 1,2,3

Goals, Objectives, Activities, and Participants: An Umbrella for Research and Evaluation with Teachers

J. Steve Oliver **Wyatt W. Anderson**

This paper is a description of the process for setting up the research component of a teacher enhancement activity. Working within a framework of teacher enhancement the researchers set out to accomplish 4 main goals. First, it was intended that the 3 year institute would improve and deepen the teacher's science content understanding with emphasis on the nature of science. Second, the project assisted teachers in engaging their peers in a reexamination of the use of instructional strategies that enhance student understanding. Third, the design of the project established Leadership Resource Teams of four teachers, a supervisor, and a college faculty member who created curriculum and assumed a mentoring role with other teachers in the outcomes of the institute. Fourth, the project involved administrative and community representatives in awareness of and support for strengthening science in schools. The research and evaluation related to actual outcomes related to these four goals is instructive to future projects with a goal of teacher enhancement. Specifically, the selection of school districts who then took responsibility for selecting representatives as participants showed itself as a vital link in creating a true team approach to the improvement of science in schools.

Byrd, Steven **Session 7.06** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency A

Middle School Science Teacher Needs and Educational Reform in Florida

This study examines extensive qualitative and quantitative data obtained from a middle school teacher questionnaire distributed to grades 6-8 science teachers across Florida. Teachers were asked to respond to a series of questions aimed at identifying their beliefs and teaching practices in the science classroom. In addition, they were asked to provide narrative comments about their most significant teaching needs. In analyzing and interpreting the database of questionnaire responses and open-ended teacher responses in this study, it was found that middle school science teachers in Florida have many critical needs that continue to go unaddressed or unmet. Findings from this study complement a series of companion studies undertaken to investigate the perceived needs of K 12 science and mathematics teachers in relation to state-wide educational reform in Florida. Similar to the findings of those studies, the trends noted in this study of middle school science teacher needs are not encouraging with respect to the educational reform goals of Florida's *Comprehensive Plan* (1989).

Cajas, Fernando **Session 3.06** **Friday, March 21, 1997**
7:00pm-8:30pm
Kent 1,2,3

Teaching Technology, Teaching Science

The complexities of teaching technology in K-12 education are analyzed. The STS movement as educational reform is criticized. A theoretical framework in which the concept of technology has three complementary meanings: 1) conceptual system (knowledge), 2) concrete system (artifacts), and 3) social practice (activity) is introduced. Using the topic of energy, the distinction between science and technology and its implications for teaching science is approached. The very existence of technological knowledge which includes terms as "optimization", "design", "quality", etc. is discussed. The technological knowledge that would be taught in K-12 education, the scientific knowledge that has to be known, and the social implications of teaching this topic (energy) are discussed. The complexities of teaching and connecting scientific, technological and sociological knowledge are discussed. The goal of scientific literacy is problematized and a movement toward technological literacy is suggested.

Calvert, Renna B. **Session 3.11** **Friday, March 21, 1997**
7:00pm-8:30pm
York 1,2,3

Middle School Science Teachers' Reflections on Long-Term Participation in a 3-year Institute

Thomas Elliott Patricia Schlegel Denise K. Crockett J. Steve Oliver

Participants in a middle school science institute were interviewed during the third summer to examine the impact on their teaching and professional activity. After the interviews, each of the researchers prepared a concept map of the relationships which were found between statements given by the teachers. Four broad areas of impact were constructed. These were: (1) science knowledge; (2) professional development; (3) instructional methods; and, (4) providing inservice to fellow teachers. Each area of impact documented change in the participants. In area 1, the most common responses related to the enhancement of scientific knowledge and broadening their perspective of science. In area 2, almost all participants gave responses centered on the development of attitudes and beliefs such as increased confidence, increased competence, decreased apprehension/anxiety, and increased ability to impact learning. Area 3 was characterized by statements related to teaching behaviors such as teaching for understanding, using technology, using more resources, and conducting more hands-on activities. Area 4 documented that many of the participants were moving toward a goal of increased involvement in professional organizations, providing inservice, and leadership at the school level.

Cannon, John R. **Session 16.04** **Monday, March 24, 1997**
8:30am-10:00am
Regency A

An Autopsy of an Elementary Science Program Implementation

David Crowther

The research base regarding the implementation of new science programs is dated and minimal. With the publishing of the AAAS *Benchmarks* and *National Science Education Standards*, more public school districts might be considering changing their science curriculum and instruction. The purpose of this study was to gauge elementary teachers' attitudes about a recent implementation of a contemporary elementary science program in a large county school district in northern Nevada. "Implementation" was defined as the school district's process of assisting teachers in teaching the new science program. The program was Scholastic's *Science Place*. A purposeful, stratified sample of 140 elementary classroom teachers(total n = 672) were sent questionnaires asking for their opinions about the implementation of the new science program. Results suggest a strong negative reaction from the teachers. In general, the teachers reported that the school district did not offer an appropriate method for implementing the new science program. Areas of current concern, along with a prescription for enhanced future implementations will be discussed.

Carlone, Heidi **Session 8.11** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency E

Factory Goop, Albino mice, X-rays: Exploring Students' Explanations of Mutation via Student-generated Computer Models

This paper explores the use of student-generated computer models as a new way to assess students' understanding of natural phenomena. The dynamic representation of the students' ideas, combined with thoughtful student explanation of the model, illuminates students' constructions of the scientific phenomenon being modeled. In this study, three students' differing explanations of mutation are evaluated via each student-generated computer model and an accompanying student explanation. All three student models depict mutation as observable and abnormal, and altered DNA as always producing the effect of mutation. Students' explanations of the models indicate, however, a more sophisticated understanding of mutation. Constructing computer models allows for students to build, organize, and elaborate their knowledge of a natural phenomena. Thoughtful explanation about the models provides opportunities for students to reflect on that knowledge. For researchers and practitioners, this model-building and explanation process provides a unique window into students' conceptions of scientific phenomena.

Carlsen, William S. **Session 17.12** **Monday, March 24, 1997**
10:30am-12:00pm
Regency F

Never Ask a Question if You Don't Know the Answer

This paper uses discourse analysis to describe and interpret teacher and student talk during science lessons on topics both familiar and unfamiliar to the teacher. Philosophical and sociolinguistic perspectives on the form of arguments ground the analysis, which demonstrates that in modeling scientific argumentation, teacher knowledge affects both argument structure and the "extra-argumentational" strategies--e.g., recovering the floor--that teachers use. Analysis focuses on biology and chemistry lessons taught by the author in public school classrooms in subsequent years.

Carlsen, William S. **Session 12.01** **Sunday, March 23, 1997**
10:30am-12:00pm
Butterfield

Probing Teachers' Beliefs About the Social Nature of Science, Using a Web-Resident Computer Adaptive Test

One challenge of conducting research informed by sociology of science is the dearth of good instrumentation for gauging teachers' and students' views on the social nature of science. This paper demonstrates an approach to assessment that provides for standardization and flexibility, and demonstrates the usefulness of the approach through the analysis of how 20 teachers' views (measured instrumentally) are subsequently manifested in original curriculum projects, designed by the teachers. The instrument is a network-resident computer adaptive test, which is based on Aikenhead & Ryan's (1992) extensively baselined "Views on Science-Technology-Society" (VOSTS) instrument. The wrinkle we have added is to take a time-consuming paper-and-pencil test, streamline its administration using a hierarchical adaptive structure, and then install it on the World Wide Web, where it can be accessed from anywhere with an Internet connection. When respondents launch the instrument, web-browser pages are generated dynamically using a question database and a scripting engine, both located elsewhere. People attending this session will have the opportunity to try the testing system. The paper will present the results of administration of the instrument to 20 teachers attending a three-week environmental sciences inservice program conducted in July, 1996.

Carola, Maria Helena Rijo **Session 9.12** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency D

Some Contributions for a Pedagogical Treatment of Alternative Conceptions: An Example From Plant Nutrition

Adelaide Neto Vaz **António J. Neto**

This paper describes a field research on alternative conceptions regarding plant nutrition and based on the application of an adequate questionnaire composed of multiple choice and linking-words with descriptive explanation items. Two groups of students, both attending a five year university Portuguese course, specially designed for biology and geology teacher education, were investigated. One of the groups corresponded to first year students while the other had to do with last year subjects, that is, with students that were having their preservice specialized training. Some of the more relevant conclusions of the study include a few important common features related to the alternative conceptions of the two groups of students, such as their anthropomorphic nature, their observable characteristics, the equal tendency of those questioned to move from specific meanings to others, and their particular character. Tentative inferences about the possible origins of the alternative conceptions identified, such as the ones related to the eventual educative failure of the teaching and learning process were also attempted. Finally, a few suggestions regarding possible teaching and learning approaches aimed at assuring a more fruitful treatment of the alternative conceptions on plant nutrition are also presented.

Carter, Glenda **Session 14.08** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency C

Tool Usage by Ninth Graders to Mediate Learning about Circuits

Susan Westbrook

The purpose of this study was to examine the usage of "science tools" by ninth graders to develop an understanding of circuits. The verbal and nonverbal behaviors of twenty-six ninth graders were recorded over a three week period using videotapes, audiotapes and field notes. Using a case study methodology, student tool usage, peer mediation of student tool usage and instructor mediation of student tool usage was analyzed. Findings of this study have several implications for using science equipment to mediate learning. Learning can be mediated by "science tools" only if appropriate "everyday tool" analogies are accessible to students. Students who can supply "everyday" analogies become "tool experts" regardless of the viability of the analogy. The "tool experts" often determine how and by whom the equipment may be used. Explanations by peers or by the instructor during whole group discussions about data collected that does not access the tool for other individuals in the class may not be effective in mediating understanding.

Cavallo, Ann M. L. **Session 13.05** **Sunday, March 23, 1997**
2:30pm-3:30pm
Kent 1,2,3

Meaningful Understanding of Genetics Topics Among Underrepresented, Advanced High School Students in a Health Sciences Program

Kristina Coats **Martin Shaffer** **Wendy Taylor**

This study examined patterns in reasoning ability, meaningful learning orientation, and meaningful understandings of genetics among advanced high school students of primarily underrepresented groups in science, who were participants in a summer health sciences program. The purposes of this study were to 1) describe patterns in reasoning ability, meaningful learning orientation, and meaningful understandings of genetics across gender and ethnic groups; 2) examine possible differences in reasoning ability, meaningful learning orientation, and meaningful understandings of genetics that may be a factor of gender, ethnicity, or the interaction of these variables, and; 3) explore possible relationships and predictive influences of reasoning ability, meaningful learning orientation, gender, and ethnicity on students' attainment of meaningful understandings of genetics topics. Questionnaires and test instruments were administered to students during the genetics course, which was part of the intensive, six week program. Results indicated differential patterns in meaningful learning, reasoning ability and genetics understanding among students of different gender and ethnic groups. This research may help educators better understand differences in learning among their students so they may plan curricula and instruction in their science classrooms.

Chagas, Isabel **Session 17.08** **Monday, March 24, 1997**
10:30am-12:00pm
Regency B

Scientific Culture and Science Education in Europe: An Analysis of Science Curriculum

M. Teresa Oliveira **Giuseppe Marucci**

The objectives of this study were: to identify common aspects and differences between science curricula from 16 different European countries in which concerns experimental work and new information technologies; to discuss the results regarding the creation of networks connecting schools in the countries considered. Reports about how science education is delivered and scientific culture is conveyed from the 16 countries were analysed according to an open content analysis methodology. The analysis enhanced heterogeneous dimensions about how science teaching takes place in the different countries. Contents are similar but the actual classroom practice is quite different. Experimental work does not have the same status, working as an exclusion feature instead of promoting scientific development specially between rich and poor countries. Information technology has originated a variety of school projects with the purpose to create networks involving both formal and informal education institutions. However, the fact that European students have different basic training in science is an impeding factor for actual communication throughout school-based networks.

Champagne, Audrey B. **Session 6.07** **Saturday, March 22, 1997**
10:30am-12:00pm
Kent 1,2,3

An Assessment Framework for Science Literacy

Vicky Kouba

An assessment framework for science literacy was developed from a cognitive analysis of literacy and communication as they are represented in national standards for school science. The development of the assessment framework was anchored in (1) perspectives on literacy contained in the literature of English education that focuses on language skill acquisition and rhetoric; (2) perspectives on the cognitive attributes of literacy contained in the literature of cognitive science; and (3) perspectives on the attributes of scientific discourse contained in the literature of the sociology and philosophy of science. The assessment framework for science literacy reflects: (1) types of literacy, for instance, literacy that is culturally defined and literacy that is defined by the academic disciplines; (2) different levels of literacy, that is literacy that is basic, high, or defined by school grade level; and (3) facets or aspects of literacy including discourse, argumentation, explanation, attitudes, habits of mind, ways of knowing, methods of inquiry. The framework provides examples of performances or student work exemplify scientific reasoning as well as demonstrating how inferences about the quality of reasoning are derived from students' discourse.

Chan, Ke-Sheng **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Effectiveness of Interactive Historical Vignettes in Enhancing HS Students' Understanding of the Nature of Science

The purpose of this study was to evaluate whether Interactive Historical Vignettes (IHVs) can effectively enhance high school students' understanding of the nature of science. A pretest-posttest nonequivalent control group design was employed to investigate the impact of infusing IHVs into high school science instruction in Taiwan on student understanding of the nature of science and science achievement. Two intact 10th-grade physics classes selected based on convenience were randomly assigned to the experimental and control groups of the study. Students in the experimental group were exposed to IHVs in the physics class during the eight-week treatment period whereas students in the control group were not. Understanding of the nature of science was measured by the Chinese version of Nature of Scientific Knowledge Scale (CNSKS). Science achievement was assessed by the Physics Achievement Test (PAT) developed by the author for this study. MANCOVA and ANCOVA were used to analyze the data for any significant difference between the two groups. Preliminary results indicated that students who received the IHV treatment achieved significantly better understanding of the nature of science than students who did not. These findings provide empirical support for using IHVs in high school science instruction to facilitate conceptual change in students' understanding of the nature of science.

Chang, Chun-Yen **Session 9.06** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Initiating Change in Students' Achievement and Alternative Frameworks Through a Problem Solving Based Instructional Model

James P. Barufaldi

The main purpose of this study was to investigate the effects of a problem solving based instructional model on earth science students' achievement and alternative frameworks. In addition, students' opinions toward the problem solving based instructional method were also investigated. The investigations employed a pretest/posttest control group design to detect any significant change. The 172 participants enrolled in four earth science classes received six weeks of the problem-solving based instruction. Selected items from Taiwan Entrance Examinations for Senior High School were used to measure students' achievement in earth science content. An open-ended question instrument was developed by the researchers to examine students' conceptual change. A 10-item Likert-type questionnaire was administered to the participants of the experimental group to explore student opinions toward the problem solving based instruction. Results of an analysis of covariance on achievement posttest scores revealed that the problem solving based instructional model did significantly improve the achievement of students, especially at the application level. A chi-square analysis on students' alternative frameworks measure indicated that students taught using the problem solving based instructional model did experience significant conceptual changes than did students who were taught by the traditional-lecture type teaching method.

Chen, Catherine **Session 3.04** **Friday, March 21, 1997**
7:00pm-8:30pm
Cermak

Putting the ME in Group MEmbership: Negotiating Access into a Community of High School Scientists

This ethnographic study seeks to better understand the dimensions of how language and social interactions influence learning in a high school physics classroom by specifically focusing on students' discourse as they are engaged in collaborative group work. Such analysis of the dynamics of collaborative group work and membership in a group is important for understanding the rules and norms that mediate students' conceptions of, and access to, school science. This study shows how the interactional spaces that are created, shaped, and enforced by members of one particular group affect students' views of what counts as physics, whose knowledge counts, and who has access to such knowledge.

Chen, Chung-Chih **Session 3.10** **Friday, March 21, 1997**
7:00pm-8:30pm
Ogden

The Development of a Questionnaire for Assessing Teachers' Beliefs about Science and Science Teaching in Taiwan and Australia

Peter C. Taylor **Jill M. Aldridge**

This paper reports part of a cross-national study of science classroom environments in Taiwan and Australia. Specifically, it focuses on the development and validation of a questionnaire to assess student perceptions of teachers' beliefs about science and science teaching. The questionnaire has two scales called Inquiry Process and Epistemological Status which assess teachers' view of science and another two scales which assess teachers' view of school science. Each scale ranges from 'traditional' to 'post-modern'. The development process included the translation of the English version into Chinese, the independent back translation of the Chinese version into English again by people not involved in the original translation, and subsequent changes to the wording where necessary. Further refinements were made based on interviews with students about their comprehension and interpretation of items. Administration of the questionnaire to 3,000 students in 100 grade 7–9 science classes in Taiwan and Australia supported each scale's internal consistency reliability and a priori factor structure.

Chen, I-shin **Session 4.01** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Teaching Abilities of Taiwan Elementary School Teachers on Natural Science

This study investigates the basic abilities that elementary school science teachers in Taiwan, as well as those in Kimen and Matsu areas, should possess. In this study, the elementary schools are divided into three types, in terms of the number of classes in each school: large schools (more than 40 classes), medium-sized schools (from 20 classes to 39 classes), and small schools (fewer than 19 classes). A total of 153 elementary schools (5% from each type) were randomly selected for this study and each school was requested have its natural science teachers fill out a questionnaire. This questionnaire lists the basic abilities required of a natural science teacher, within eight general categories: (A) class management skills, (B) basic knowledge in natural science. (c) aptitude, (D) ability to reflect on one's teaching, (E) assessment skills. (F) teaching methods and strategies, (G)administration and management, and (H) basic requirements of a natural science teacher, specifically from the perspective of school administration authorities. The results of a statistical analysis show that there is significant difference between male and female teachers in the following categories: class management skills, aptitude, ability to reflect on one's teaching, and teaching methods and strategies. The results also show that in terms of age difference, the following categories are statistically significant: basic knowledge in natural science, aptitude, and teaching methods and strategies. The statistical results show that in terms of service year difference too, the following categories are statistically significant: basic knowledge in natural science, aptitude, teaching methods and strategies, and administration and management.

Chin, Christine **Session 9.06** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Learning Strategies in Science: A Case Study of A Deep Approach Learner

The purpose of this study was to identify the kinds of cognitive and metacognitive strategies that students use as they construct meanings and develop their conceptual knowledge. The discourse of a group of Grade 8 students was audiotaped while they were engaged in science hands-on activities during their regular science class. The focus in this paper is on a case study of a student who showed a deep approach to learning. Analysis of the discourse transcripts produced several categories which were used to classify the different strategies used by the student. Excerpts of discourse that exemplify each of these categories are provided.

Chyuan, Jong-Pyng **Session 14.02** **Sunday, March 23, 1997**
4:00pm-5:00pm
Kent 1,2,3

Evaluating New Grade-1 Science Curriculum Taiwan: An Analysis of Children's Observation Process Skills

A new grade 1 science curriculum is designed and developed in Taiwan, and the curriculum corresponds to the demand of the National Standard of Elementary Science Curriculum. The teaching sequence of observing process skills in it are from sight sense, then touch, smell, hearing, and taste. Owing to that the new science curriculum has used on a trial basis in 48 elementary schools in Taiwan, there is a need to investigate children's observation process skills between the using new science curriculum and using current science curriculum in grade 1, in order to understand whether the developed new science curriculum is valid in elementary schools. There are 273 children using the new science curriculum and 388 children using the current science curriculum randomly selected from 48 elementary schools in Taiwan as subjects. Through detailed interview-about-events investigation and statistical analysis, children using the new science curriculum have more effective observation abilities than the children using current science curriculum. In fact, the new science curriculum offer children's more chance to sequentially use their senses to do science, and the new science curriculum is really progressive.

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Clough, Michael P. **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Longitudinal Understanding of the Nature of Science Facilitated By An Introductory High School Biology Course

The purpose of this study was twofold. First, the effect of a year-long effort in an introductory sophomore biology course to improve students' conceptions of the nature of science was investigated using eight items from the Views On Science-Technology-Society (VOSTS) instrument (Aikenhead and Ryan, 1992). Second, to determine the resiliency of students' conceptions of the nature of science developed during this course, 49 students were followed longitudinally and administered the same items in the fall of their junior year. Significant gains occurred on seven of the eight VOSTS items at the end of the biology course. However, during the following fall statistically significant gains remained on only six items, and movement towards naive conceptions of the nature of science could be seen in each item. While some movement toward original conceptions might be expected, to determine whether or not this is a trend, the same students were again administered the VOSTS items in the fall of 1995 and spring of 1996.

Collins, Angelo **Session 17.04** **Monday, March 24, 1997**
10:30am-12:00pm
Hunt 1,2,3

Interdisciplinary Collaboration in Science, Education and Technology: Support and Hindrance

Lynn Bercaw **Todd Gary** **Amy Palmeri**

Interdisciplinary collaboration between colleges of arts and science and colleges of education is an important aspect of science teacher education reform. In this study, we report what supports and what hinders collaboration and the influence of collaboration on student learning. We examine a collaborative effort in which a molecular biology course, a science methods course, and a technology course are integrated in a six-credit unit during a summer session. Naturalistic inquiry was an appropriate research method for this study due to the importance of context in understanding the nature of collaboration. Based on observations, formal interviews, informal conversations, documents, and artifacts, we found that the circumstances supporting collaboration include common goals held by instructors. Hindrances to collaboration include previously unexamined, culturally determined values and practices. Student learning was measured by various modes of assessment, including completion of a consequential task, the development of a CD ROM resource.

Collister, Colin Trevor **Session 4.03** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Cognitive Styles and Preferences for Computer Assisted Learning in a Self-Paced Second Chance Environment

Pierce Farragher

This study examined the relationship between students' cognitive styles and their preferences for computer-assisted learning (CAL) in a self-paced, second-chance environment. The data were collected through the utilization of a pilot study, user logs, the Gregorc Style Delineator, and a questionnaire on demographics and computer-use in learning. In order to corroborate this data, interviews were conducted with twenty students who participated in all aspects of the study at a storefront school that enabled young adults and adults to obtain high school diplomas. Demographic information provided a basis for comparison of the study population with secondary school students, other young adult and adult learning centres, and general drop-out populations in Ontario. Comparisons of age groups and gender were made within the study population and with other student populations regarding cognitive styles and computer-assisted learning. Findings in the present study supported several statements found in the literature regarding an increase in achievement based on either computer-assisted learning resources, the self-paced environment, or both. The study also supported research that suggested changes in behaviour to computer-use would occur when the CAL was more aligned to student coursework and with ease of use, regardless of cognitive style. Comparisons to other adult education centres resulted in similarities when computer-use was correlated to positive learning situations.

Coppola, Brian P. **Session 9.03** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook I

Using Peer-Facilitated Structured Study Groups (SSG) Within a Large First-Year University Chemistry Program

Scott T. Lefurgy Douglas S. Daniels

Structure and Reactivity, a two-term course based on contemporary mechanistic organic chemistry that we instituted in 1989, is the cornerstone of our completely revised undergraduate chemistry program. A cohort of 120 Honors students participate within the 1200-student course for their standard coursework and examinations, earning their Honors credit by participating in weekly 2-hour sessions that are shaped, metaphorically, along the lines of a "performance studio" in the Arts. Students bring their work on authentic projects to the sessions and engage in structured peer group critiques facilitated by upper-level undergraduate leaders. Most of the projects broaden and deepen the students' learning of associated course topics, and usually involve mastering tools used by practicing chemists, especially library resources and research-grade molecular modeling software. We have examined, using a think-aloud, performance-based task, the extemporaneous problem-solving skills of students who had taken their chemistry with this greater emphasis on developing "teaching skills" in the group work. These students demonstrated a "cognitive pathway" that was more comparable to experienced chemists (faculty and graduate students) than their non-group counterparts.

Coulter, Bob **Session 12.09** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook IV

The Promise and Perils of Network Science

Joe Walters

This research is based on the first two years of a three-year research project sponsored by the NSF on "Network Science" projects. We define a Network Science project as an endeavor that involves a number of classrooms in schools distributed across a region in which each classroom conducts one part of a scientific experiment and then shares the data it collects with the other schools. Each school then analyzes data from a variety of locations. The authors have been working with teachers and students across the country involved in such projects. This paper summarizes the findings of that work and presents recommendations for the future use of networking technologies in K-12 science classrooms. We found many successful implementations of Network Science, but none which could be considered a model or a prototype of how to design such a project. As the Network Science approach matures, it will be incumbent upon curriculum developers to attend to teachers' skills in data analysis, their reasons for joining, and their needs for support along the way. The development of appropriate student support structures and the design of simple, reliable, and flexible software and hardware configurations will also need to be attended to.

Cox, Anne Marshall **Session 10.07** **Saturday, March 22, 1997**
4:00PM-5:30pm
Oak Brook IV

Teacher-Student Interactions at a Children's Discovery Center

William F. McComas

As children's museums become increasingly more popular, they serve as ideal environments for supplementing formal education programs. Current research articulates the importance of the teacher's role in planning pre- and post-field trip activities, but there is a missing link describing the teacher's role during the visit. This study inquires into the interactions between elementary teachers and students during a field trip to a Discovery Center at a large urban Natural History Museum where students play, explore, and self-select activities. This differs significantly from traditional exhibits where students are guided by a museum docent. Most teachers in this study viewed their role as a facilitator or one who ensured student involvement in hands-on experiences, but only half of these teachers consistently displayed this behavior. Teachers also took on roles of a manager and observer who exhibited various formal school behaviors during their visit. Students manipulated a variety of objects with and without teacher assistance; however, teachers who initiated hands-on experiences had students who were engaged in a greater variety of activities for greater lengths of time. Students of classes who did not have teachers who initiated experiences, spent the majority of time with a limited number of popular exhibits.

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Craven, John A., III

Session 17.05

Monday, March 24, 1997
10:30am-12:00pm
Kent 1,2,3

Links Between Preservice Preparation, Teaching, and Learner Outcomes: Salish I Findings from Iowa

The Salish I Research Project, conducted by a consortium of institutions, sought to understand and improve the features and effectiveness of tertiary preparation programs for secondary school science and mathematics teachers. This study examined data from one institution within the consortium - the University of Iowa's Science Education Center. Analysis of the data from this site has yielded evidence of links between the performance characteristics of new teachers (NTs) and the features of the preservice program of the Iowa teacher preparation program. The findings of this study may offer insight into a possible model for effective science teacher preparation program.

Crawford, Barbara

Session 16.02

Monday, March 24, 1997
8:30am-10:00am
Kent 1,2,3

A Preservice Teacher's Design of Inquiry-based Instruction: A Collaborative Case Study

The purpose of this collaborative case study was two-fold: first, to explore a preservice teacher's attempt to design and carry out inquiry-based instruction and second, to examine the influence of collaboration on a preservice teacher's understanding of teaching. This preservice teacher was unique in her creation of two units involving tenth grade biology students in doing long term investigations. Questions explored in this study included what factors contributed to this preservice teacher's undertaking this challenging form of instruction, what were constraints and supports in her teaching context, and what changes would she make in her instruction as a practicing teacher? This case study incorporated various perspectives including those of university supervisors, students, mentor teacher, the researcher, and the preservice teacher. Exploring factors that contributed to this preservice teacher's successes as well as her frustrations in guiding students in authentic investigations can contribute to supporting preservice teachers in enacting similar inquiry-based instruction. An important outcome of this case study would include giving attention to the authority of experience of the preservice teacher.

Crockett, Denise K.

Session 3.11

Friday, March 21, 1997
7:00pm-8:30pm
York 1,2,3

In Their Own Words: Teacher's adoption and use of an instructional innovation

J. Steve Oliver   Renna B. Calvert

This paper reports the results of a qualitative study which is based on the written descriptions given by institute participants on their adoption of an instructional innovation called "How Can You Know". During each of the three summer institutes, participants responded to a request to describe a teaching activity that had a primary objective of teaching students how we come to know. In the initial institute(1994), participants were asked to perform this task as a pre- and post- workshop task. In the summers of 1995 and 1996, the task was performed as a post assessment. The first summer's responses indicated a difficulty in understanding the task and subsequent difficulty in describing how they would attempt to teach this to students. The second summer showed growth in understanding the concept for approximately half of the participants, but difficulty for the remainder. The third summer, however, showed that almost all of the participants had developed an understanding and were showing ownership for this innovation as part of their teaching repertoire. The implication is that the teachers needed more than a single introduction to the topic in order to incorporate it as a substantive portion of their curriculum and instruction.

Crowther, David T. **Session 10.02** **Saturday, March 22, 1997**
4:00pm-5:30pm
Hunt 1,2,3

A Substantive Theory of How Preservice Elementary Education Majors Experience Learning in an Alternative Content

Ron J. Bonnstetter

In response to national reform movements an introductory biology content science course specifically designed for elementary and middle level education majors has been developed and taught for three years in a collaborative manner between the department of Life Sciences and the Teachers College. Quantitative results show significance increased in attitude, confidence, and learning and teaching content science for each semester that the course was taught. This study is an in-depth qualitative multiple case study using cross case analysis to explore the reasons of the attitude and confidence shift. A substantive theory of learning emerged about how the participants in the course learned science in this alternative setting. The substantive theory clearly labeled hurdles which each of the participants experienced and overcame with participation in the course. The hurdles identified in the theory begin with: a) hesitations and reservations at the onset of the course, b) awareness and enjoyment in which science is recognized as something other than a traditional textbook/lecture approach to learning, c) an intrinsic shift in the motivation of the learning of science, d) large gains in self confidence and self efficacy, and e) culminates with empowerment to the teaching and learning of science in the elementary classroom.

Cunningham, Christine M. **Session 12.01** **Sunday, March 23, 1997**
10:30am-12:00pm
Butterfield

Needed: New Methods to Assess Sociological Understanding of Science and Analyze its Manifestations in Classrooms

This paper addresses some methodological issues that surfaced in a research project designed to investigate the effect of teachers' sociological understanding of science (SUS) on their classroom practices. Specifically, it focuses on two problematic areas: (a) how to assess teachers' sociological understanding of science and (b) how to analyze data to make (and support) claims about the classroom manifestation of knowledge about science. Underlying these issues was the need to define "sociological understanding of science" in a nonreductive manner that accounted for the robust nature of teachers' knowledge about science. To explore in more detail the types of analysis questions that pervaded the study, the paper will describe and discuss the data and evidence supporting one finding of the study: teachers with strong SUS more authentically and frequently convey information about the practice of creating scientific knowledge than weak SUS teachers. The methodological issues raised in this paper will be the subjects for a more general dialogue about the new types and characteristics of data and methods of analysis that will need to be developed for research investigating the sociology of science in classrooms.

Czerniak, Charlene M. **Session 6.06** **Saturday, March 22, 1997**
10:30am-12:00pm
Hunt 1,2,3

Teachers' Beliefs About Using Cooperative Learning in Science

Andrew T. Lumpe

Current science education reform documents include cooperative learning as a key idea in school science programs. Teachers' beliefs about curriculum and instruction may play an important role in the implementation of reforms such as cooperative learning. In this study, we sought to examine the influence of K-12 teachers' beliefs on their intent to implement cooperative learning in their science classrooms. The Theory of Planned Behavior was used to examine the influences of K-12 teachers' attitudes, subjective norm (social support), and perceive behavioral control (external influences). Specific suggestions for addressing teachers' beliefs about cooperative learning and staff development ideas are offered.

Dagher, Zoubeida R. **Session 6.02** **Saturday, March 22, 1997**
10:30am-12:00pm
Butterfield

College Student's Generic and Specific Conceptions of Theories

Saouma Boujaoude

The purpose of this study is to explore how some students understand the nature of evolutionary theory and to document this understanding in relation to their current understanding of theories in general. Semi-structured interviews were conducted with 15 college biology seniors. Students responses revealed that their general understanding of scientific theory seem to undermine their understanding of the nature of evolutionary theory. The findings suggest that a generic treatment of theory construction and validation such as that promoted in discussions about the scientific method should be avoided. We recommend that a more functional understanding of science is better accomplished by discussing the attributes of scientific knowledge in the context of learning about specific theories. We also recommend that a generic reconstruction of scientific knowledge be grounded in the discussion of specific theories, and consistently qualified and refined throughout the school year. We believe that a constant dialogue between the specific and generic attributes of theories provides an efficient mechanism for 1) refining students preconceptions about the nature of science, 2) enhancing the development of students metacognitive skills, and 3) preserving the spirit of inquiry around the content and the process of science.

Dahncke, Helmut **Session 7.03** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook II

Computer Simulation as a Tool of Research in Science Teaching

For our research project we developed a combination of methods consisting of computer simulation, concept mapping and the thinking aloud method including, computer programs for the evaluation. The project deals with the connection between science teaching and action. For this purpose verbalized knowledge (tests including concept mapping) and actions of the subjects (intervention in computer simulations together with the thinking aloud method) are established and recorded at two stages in a teaching phase which is significant both for society and for physics (energy consumption and energy supply). This is linked with teaching approaches (traditional German science teaching and teaching according to the Anglo-Saxon model: Science - Technology - Society). We conduct the investigation in three project components: A "Heat energy consumption in a detached house" / B. "Energy consumption at home" / C. "Energy supply in a dynamic system of different power stations". The data were recorded until June 1996 inclusive and are actually being evaluated. At the time of the presentation all results will be there.

Damnjanovic, Arta **Session 17.10** **Monday, March 24, 1997**
10:30am-12:00pm
Regency D

Ohio SSI Factors Associated With Urban Middle School Science Achievement: Differences By Student Sex and Race

Jane Butler Kahle

The purpose of this study was to assess sex and/or race differences in student science achievement in urban middle schools where teachers had been involved with Ohio's SSI professional development and to explore possible explanations for these differences. This study utilized a causal comparative research design involving both quantitative and qualitative methods. Questionnaires measured student science achievement (using NAEP public release items) and Ohio SSI factors associated with science achievement. Classroom observations and interviews situated the study and provided background for interpreting findings. Results revealed that females scored significantly higher on the science achievement test than males and that White students scored higher than African American students. Classroom teaching strategies (e.g., cooperative learning, inquiry, and problem solving) were significant achievement predictors for females. Individual and socio-cultural factors (e.g., negative peer and environmental influences and attitudes toward science) were significant achievement predictors for African American males. Classroom observations revealed that male students showed greater resistance to classroom teaching than did females. These findings support the effectiveness of the Ohio SSI reform efforts and described variations in predictors of achievement between female and male middle school students, both across and within racial groups.

Dass, Pradeep Maxwell **Session 3.09** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook IV

District-wide Professional Development of Science Teachers: Factors Influencing the Implementation of the Chautauqua Model

The dissemination of the Iowa Chautauqua Program (ICP), through the National Diffusion Network (NDN), as an exemplary model of professional development of science teachers has resulted in many new professional development programs emulating the Chautauqua model in diverse settings across the nation. One such program was developed in a large district setting adhering closely to the principal features of the ICP. The issues, concerns, and problems associated with the development and implementation of this program were studied in a qualitative manner from inception through the first complete year of implementation of the program. Data was collected through individual and focus group interviews of participating teachers and district and school administrators, participant observations by the investigator during all of the training workshops through the year, teacher journals, and regular communication with the program director. Data was analyzed using standard qualitative data analysis procedures. Concern related findings were further analyzed using the framework of the Concerns Based Adoption Model (CBAM). Results indicate some concerns which do not neatly fit into any of the stages of concern described in CBAM.

Dass, Pradeep Maxwell **Session 6.05** **Saturday, March 22, 1997**
10:30am-12:00pm
Harger

Interdisciplinary Courses for General Education Requirements (GER) in College Science: Perspectives of University Professors

This study was designed to explore the perspectives of university professors regarding the desirability and feasibility of offering interdisciplinary courses to satisfy the General Education Requirements (GER) in science for non-science major students at college. Fifteen university professors were individually interviewed regarding their views. The interviews focused around questions related to the purpose of science courses in liberal arts education, the extent to which courses taught by the interviewees fulfilled those purposes, and whether or not courses integrating different disciplines of science and/or integrating science with other disciplines would serve the non-science major students better. The interview data was coded and analyzed using standard qualitative data analysis procedures. While the results reveal two schools of thought—one in favour and one against the said modification of GER science courses—a more important finding of this study is the exposure of various problems attendant to college GERs at large public universities.

Davis, Kathleen S. **Session 16.07** **Monday, March 24, 1997**
8:30am-10:00am
Regency D

Meeting Women's and Girls' Special Needs: "Gender-sensitive" Environments and the Roadblocks Women Science Educators Face

This paper examines the obstacles, tensions, and conflicts that women science educators faced as they facilitated science support groups that aimed to be "gender-sensitive" and provide women and girls with opportunities to legitimately participate in the science community. This study examines Explorers, a diverse after-school science club for girls, and Women in Science, a group of women working at an academic research institution. Through analysis of field notes, interviews, and group documents, the social structures and forces that impeded the implementation of "gender-sensitive" practices and the acquisition of capital are described. They include: •how educators sought to provide girls with "safe settings" to build supportive networks and engage in learning activities, but experienced conflict as they excluded boys from such contexts; •how women and girls have little voice in their education, work environments, and the science community; •how male-dominated social structures continued to make decisions that diluted and discouraged "gender-sensitive" efforts; •how the groups' members had little access to the social capital of the science community and how participants viewed such networks as competitive, aggressive, and employing discouraging and discriminatory practices; and •how, through the capital that it values and rewards, the science community disregards women's values and life experiences.

Dawson, Vaille **Session 17.11** **Monday, March 24, 1997**
10:30am-12:00pm
Regency E

To Care or Not to Care?

Recently I wrote an impressionistic tale about an event in my professional teaching life that deeply worried me. I had experienced an ethical dilemma. My overwhelming sense of an ethic of care toward a student 'at risk' compelled me to 'go behind the back' of a teaching colleague and alert the school's welfare counsellor to an impending crisis. My colleague had expressed an intention to discipline the student in such a way that I was concerned for the student's welfare. The tale that I wrote about this event served as a powerful catalyst for a period of reflective activity in which I solicited critical commentaries from colleagues and friends, and read feminist literature on ethics and caring and the value of teachers writing ethnographies about their daily lives. In this paper, I present a 'personal experience' account of my struggle to (1) resolve my professional ethical dilemma and (2) find appropriate criteria for justifying the value of my impressionistic tale.

Day, Elizabeth A. **Session 9.12** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency D

Student Concepts of Tidal Salt Marshes: What We Learn from Interviewing Students Before We Teach

Christine Ebert

The objective of this study was to assess student understanding of tidal salt marshes. An interview was administered to 11 student volunteers within one week prior to and one week after two laboratory exercises designed to explore the behavior and habitat interactions of several tidal salt marsh organisms. Data were collected on audio tapes and transcribed. Individual student responses were analyzed based on completeness and correctness using an author designed rubric. Results indicated that participants improved their completeness and correctness scores from the pre-interview to the post-interview at a statistically significant level. The results also indicated that students performed better on the post-interview for each question except one. An increase in number of responses and vocabulary detail shows an expansion of the breadth and depth of learning that occurred during this study. However, misconceptions still abound; students learned new information, but, they did not accommodate this new information. The most important implication of this study is the necessity of interviewing students prior to instruction. Misconceptions cannot be effectively addressed unless the details of students' understandings are known.

De Jong, Onno **Session 10.04** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook I

The Pedagogical Content Knowledge of Prospective and Experienced Chemistry Teachers

For many students of junior secondary level, processes like the burning of a candle or a piece of wood appear to be difficult to understand. Students' conceptual understanding of combustion is fragmented, inconsistent and at variance with scientific meanings. An important task of science teachers should be to take students' (pre)conceptions and difficulties into account and to negotiate about the meanings of specific concepts. In this context, teachers' pedagogical content knowledge plays an important role. This paper presents a study of chemistry (prospective) teachers' conceptions of how to teach the concept of combustion. Seven prospective teachers and seven experienced teachers were invited to prepare a first lesson about combustion (for students aged 14-15). The teachers were not allowed to consult any textbook. Research data were obtained from audiotaped semi-structured interviews with the teachers. Besides, their written lesson plans as well as their answers on an accompanying questionnaire were collected and analysed. The results reveal a number of important characteristics of teachers' views on teaching combustion. Interesting differences between views of prospective teachers and views of experienced teachers have also been found. Implications of the study for science teacher education will be presented.

Denning, Rebecca **Session 10.10** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency C

Using Problem-Based Learning to Improve Diagnostic Reasoning Skills for at Risk Students

Philip J. Smith

Problem-Based Learning Partnerships involve teachers, secondary students, and health care professionals from schools' communities. Students met with a health care professional who volunteered her time to mentor the students to discuss an actual medical case. The diagnosis and other pertinent data about the case, including X-rays, were given to the mentor so she could facilitate discussions. Four classes of students were assigned to be in either the control condition or the treatment condition. In both the mentor had the goal of teaching problem-solving skills using the patient case. The only difference being that when working with the treatment group the mentor and students had the additional goal of explicitly developing, and then narrowing, based on patient data, a list of hypotheses which could explain the patient's symptoms and test results. This was an urban public school and the 91 students were economically disadvantaged. Post-tests showed, there was a 27% improvement in the ability to generate a set of hypotheses and then to identify the most diagnostic test to narrow that set which is significant with $p < .005$.

Denning, Rebecca **Session 14.09** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency D

The Impact of Teaching Strategies and Resources on Group Dynamics and Student Learning

Philip U. Smith

The Biology Sleuth is a multi-media learning environment developed to vary the distribution of critical resources and the use of teaching strategies, and to study their effects on group dynamics and individual learning. The system focuses on one type of problem-solving, diagnostic reasoning, for secondary students. Students, playing the role of physicians, work together in groups of three, assigned to single computers work through nine problem-solving episodes as hypothetical patients. Initially, students are asked to identify the hypotheses which could explain the pattern of clinical results associated with each patient. Later, they are asked to run tests and interpret data for themselves. A study to examine the effects of teaching strategies and the distribution of critical resources in this environment suggests that varying these dimensions of a learning environment can have a large impact on both group dynamics and individual learning, with a 35% improvement ($p < .05$) measured in the treatment group.

Deru, David B. **Session 17.08** **Monday, March 24, 1997**
10:30am-12:00pm
Regency B

Culture and the Success Criteria for Expatriate National and Non-National in Curriculum Development

Joseph P. Riley, II

The purpose of this study was to assess the characteristics that describe the degree to which the expatriate national and her/his non national counterparts are deemed successful in a science curriculum development setting. A case study design, focusing on understanding the processes involved in the development of a science curriculum in a higher educational setting was used. It explored both the impacts of their participation and the factors mediating their success. The study utilized in depth, open ended interviews of 50 participants, followed by document analysis, observance in group meetings and work contexts. Findings suggest that several co-active cultural resources favored the expatriate national, given her/his familiarity with existing cultural nuances. However it is also indicated, that the expatriate non national had strong potential for success provided the opportunities for developing approval, acceptance and rapport with key active entities, exist in the curriculum development setting.

Dhillon, Amarjit Singh **Session 10.09** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency B

Enhancing Conceptual Understanding: Modifying Standard Examples In Geometrical Optics

In this paper text book examples from geometrical optics are discussed to show that in the process of creating simplicity and with the intention of enhancing conceptual learning, principles and concepts are briefly explained and are not sufficiently addressed. This creates problems for students when they attempt to apply the principles to differing situations. The study compares the use of standard examples and procedural rules, to the use of relevant principles and modified examples in helping to enhance the conceptual understanding of students. Within the modified examples factors which are usually not even given a mention in the standard examples were varied and their effect addressed. Findings show that the use of standard examples with certain fixed configurations, and the use of procedural instructions which contribute little towards conceptual understanding hampers the application of concepts to differing examples. It was found that when as many factors as possible were varied within the standard examples, students gained better conceptual understanding. The transfer of learning which is currently problematic amongst students, was also enhanced through the use of principles in place of procedural rules mentioned in many texts and widely used by teachers.

Dickinson, Valarie L. **Session 7.07** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency B

Children's Ideas in Science: How Do Student and Teacher Perspectives Coincide?

Lawrence B. Flick

The purpose of this study was to describe how primary teachers who purport to take student conceptions into account when teaching science design and carry out instruction, and to compare their perspectives for valuing children's ideas compare with the perspectives of their students. Three primary teachers, Kindergarten, second, and third grade, participated in case study observations and video taping of their teaching, and participated in one-hour interviews regarding their teaching of science. In addition, at least six students from each classroom were interviewed to gain insights into their content knowledge, their knowledge of the nature of science, and their perspectives of their teachers' methods and values of their thinking. Results indicated that teachers did plan lessons that focused on assessing student ideas, but often did not use that knowledge in future lessons. Results also showed that primary students were aware of teacher practices in their classrooms that showed teacher value of their ideas and thoughts, and were able to describe how their ideas were used in the classroom. Teachers were sometimes unaware of misconceptions individual students still held at the end of the unit. Implications for teaching and teacher preparation are discussed.

Dierking, Lynn D. **Session 14.03** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook I

Conducting Science Learning Research in Museums: Challenges and Opportunities

John Falk

A growing body of science museum research provides insights into who visits these institutions and in what behaviors they engage while in the museum (Falk & Dierking, 1992). What is much less understood is what visitors actually learn about science in the museum and how this information is used and incorporated into their everyday lives. Assessing the long-term impact of the science museum experience continues to be the most difficult aspect of visitor research. This position paper will describe the current status of science learning research in museums, presenting some of the challenges and opportunities that researchers face in assessing long-term learning. The paper will also provide an overview of some of the research efforts and initiatives that are attempting to investigate such long-term museum learning.

Discenna, Jennifer L.

Session 7.08 **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency C

Using "Model Maps" - The Impact on Students' Understanding of the Nature of Science

For most students, learning physics is learning how to solve problems. The ramifications of this is that few students walk away with an understanding of the conceptual underpinnings of the domain. In the research to be presented, an approach to teaching physics was developed in which problems were chosen to illustrate theories and models important to the domain. "Model Maps", similar to concept maps, were used to organize the physics problems in terms of the theories and models necessary to solve the problems. It is believed that this approach presents domain knowledge to students in a more meaningful way than typically encountered in physics instruction. In order to use the Model Maps, students needed to understand the physics knowledge as well as the nature of the theories and models themselves. Students created their own models and presented them to their peers. Results from a questionnaire and journal entries indicate that students' belief about the nature of theories and models evolved throughout the course. These findings will be discussed with an emphasis on the beneficial effects of this approach for physics instruction.

Doby, Janice K.

Session 10.02 **Saturday, March 22, 1997**
4:00pm-5:30pm
Hunt 1,2,3

Elementary Preservice Teachers' Content Knowledge: Effects of an Integrated Content Oriented Science Methods Course

The purpose of this study was to examine the effectiveness of an experimental interactive elementary science methods course which promotes the learning and teaching of carefully sequenced basic concepts in the physical sciences, while simultaneously presenting teaching methods and serving as a model for the teaching of science in the elementary school. The experimental model was compared, pre and post, in terms of content knowledge in the physical sciences and locus of control in science, with a more traditional model, which focused primarily on methods of teaching in the physical sciences and other science domains. Content knowledge was measured by a 50-item multiple choice test designed by the author of the study, and locus of control in science was measured by a 47-item Likert-type scale instrument, adapted for the purposes of this study. Results indicated that the 38 participants in the experimental model experienced significantly higher gains in content knowledge and locus of control than did the 38 participants in the traditional model. Statistical analyses conducted supported the aims of the study.

Doster, Elizabeth C.

Session 6.12 **Saturday, March 22, 1997**
10:30am-12:00pm
Windsor

Moving Toward a Richer Understanding of Students' Interaction with Dissection: Implications from an Interpretive Study

David F. Jackson **J. Steve Oliver** **Denise Crockett**

The purpose of this study is to question how the values and beliefs found in the secondary science curriculum, specifically those which are inherent in the dissection experience, relate to the personal values and beliefs of individual students. Findings indicate students' perception of the dissection experience were contingent on the consistency (or lack thereof) of their personal value systems with the underlying factors found in each of four dimensions of dissection: the moral issues prevalent in the minds of students; epistemological issues; the phenomenon of physical aversion to the experience; and the issue of familiarity. Embedded in these four dimensions are degrees of agreement with seven beliefs inherent in the practice of dissection as an aspect of the biology curriculum, and related to the issues of: killing of animals for the purpose of learning; touching the dead body of an animal; the importance of the degree of similarity between the body of the animal and the human body; cutting apart, probing, and pinning of a dead animal's body; students' understanding of the structure and function of the animal's internal anatomical structures; seeing or smelling the dead body of an animal; and the dependence of students' interpretations of their dissection experiences on their degree of familiarity with similar experiences.

Druker, Stephen L. **Session 17.12** **Monday, March 24, 1997**
10:30am-12:00pm
Regency F

Analyzing the content of students' arguments through the Toulmin model of argumentation

Gregory J. Kelly

This paper reports on an investigation of students' use of arguments and links their reasoning to subject matter knowledge. The research methodology applied discourse analysis derived from Toulmin's layout of arguments to study students' spontaneous talk in laboratory settings. This methodology offers an alternative for researchers interested in investigating how students use conceptions when solving problems in small groups. To link student reasoning to subject matter knowledge, we focused on argumentation errors students made while working together to solve a hands-on problem solving task in electricity. Through this process, the conversational and pedagogical consequences of these errors are assessed. The paper concludes by evaluating the methodological implications of this analysis as well as the limitations posed by this approach.

Duggan-Haas, Don **Session 16.09** **Monday, March 24, 1997**
8:30am-10:00am
York 1,2,3

Linking Teacher Preparation to Teacher Performance

Quasim Alshannag **Lizete Carvalho** **Washington Carvalho**
Fernando Cajas **James Gallagher** **Joyce Parker**

The Salish Research Project is a major study of the effectiveness of teacher education programs for secondary mathematics and science teachers. In doing so the project selected 10 universities across the country with differing teacher training and certification programs. At this moment, Phase I of the project (Salish I) is dealing with the analysis of the data collected during three years of research. We have data for a minimum of 12 teacher years from each of nine universities. We propose a symposium for sharing and discussing our findings that are framed in the following research question: "What are the links between students' learning outcomes, new teachers' performance, and their teacher preparation programs?" The symposium will address the following topics: Background and Rationale of Salish, Data Description, Methodological Issues, Theoretical Perspectives on Teacher Preparation, Content Knowledge and Teacher Performance, and Perspective on Conceptual and Constructivist Teaching.

Duit, Reinders **Session 8.08** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency B

Conceptual Change During a Unit on Chaos Theory Induced by Means of Analogies

Michael Komorek **Wolff-Michael Roth**

This study is part of a larger project regarding the educational reconstruction of basic ideas in chaos theory. The particular focus here is on spontaneous and guided analogy generation and analogical reasoning processes which were studied in a Grade 10 curriculum focusing on the chaotic behavior of a magnetic pendulum. Instruction oscillated between small-group, open-inquiry investigations and whole-class conversations in which students were given opportunities to negotiate new understandings. The data provide deep insights into the ways students tried to make sense of given analogies and their struggles to use the analogies to understand the chaotic pendulum. It appears that successful analogical reasoning in open-inquiry settings needs a certain amount of guidance to be fruitful and successful. This study led us to a more cautious view of the significance of analogies in conceptual change processes. However, our data also suggest that analogies can be powerful mediators of learning in those cases where (a) students come to generate their own analogies and (b) the analogy bridging processes are carefully guided.

Durham, Mary Ellen **Session 14.09** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency D

An Examination of Elementary Student Dialogue While Using Microcomputer-Based Laboratories to Study Motion

John C. Park

This study examines the dialogue of fifth graders engaged in the study of motion using MBLs. Two intact classes (35 students) used identical MBL equipment, activities, data collection functions, and procedures to explore concepts about motion. Prior to each MBL activity, students discussed how the phenomenon would be graphically represented and provided reasons for their predictions. Discussions in Class A were between the instructor and the entire class. In Class B discussions were among small student groups. Student dialogue was recorded and examined to determine if the discussions reflected patterns in the development of conceptual constructs. Student comments were categorized by length of statement and classified as support statements, challenges, or requests for help. Results indicated that the number of support statements for both classes increased with each MBL activity. However, longer and more challenge statements were generated in small group discussion than in large group discussions. Students in small groups tended to seek help from peers, while those in the large group requested teacher assistance. This analysis suggests the existence of a link between small group verbal interactions and the extent of conceptual development.

Eaglin, Phillip G. **Session 6.12** **Saturday, March 22, 1997**
10:30am-12:00pm
Windsor

The Relationship Between Technology-Enhanced Biology Instruction and the Teaching and Learning of African-American Students

The focus of this study was on the teaching and learning of the most affected group of students in science, African Americans, in relation to technology-enhanced biology instruction. The inquiry centered on the following factors related to student learning: student empowerment, student change in attitudes, motivation, and understanding, and teacher change in attitudes, expectations, and ability to motivate. This study also addressed the current debate on the potential for technology to widen or narrow the learning gap between the nation's *haves* and *have-nots*. A premise underlying this study was that students from all achievement levels and sociocultural backgrounds want to succeed at learning and want to be in an environment in which the teacher tries to make it possible to do so. The purpose of the study was to document insight into the effectiveness, as indicated by teacher and student change, of technology-enhanced instructional strategies in improving African-American students' biology learning and their European-American teacher's ability to teach them.

Ebenezer, Jazlin V. **Session 13.01** **Sunday, March 23, 1997**
2:30pm-3:30pm
Butterfield

Hypermedia for Relational Conceptual Change

This study is a component of a major ethnographic research project that documented the exploration as well as the negotiation of grade eleven chemistry students' conceptions of solubility by a teacher-researcher collaborative team. This particular paper reports how a personal-social constructivist, HyperCard environment, was used to incorporate two conceptualizations the students had about the solution process: (a) the transformation of a solid to a liquid; and (b) the chemical combination of a solute and a solvent. The paper traces the nature of students' understandings about the solution process in the HyperCard environment. The paper argues that HyperCard may be considered as a suitable environment to learn the microscopic aspects of solution chemistry. HyperCard environment is also useful to explore, negotiate, and assess students' understanding. Issues pertaining to the learning of solution chemistry in a constructivist, HyperCard environment are discussed.

Ebert-May, Diane **Session 9.03** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook I

An Experimental Approach for Testing an Innovative Instructional Model for an Introductory College Biology Course

Julie Baldwin **Dennis J. Burns**

An experiment was conducted to determine what works to increase biological literacy in a large, introductory biology course for non-majors. A traditional lecture/lab biology course was compared with an experimental lecture/lab. The traditional course (control) lecture involved delivery of information by the instructor and confirmatory labs. The experimental course was based on highly interactive lectures with requisite cooperative groups and inquiry-based, researched-oriented laboratories. Outcome variables included process skills, content and self-efficacy. Controlling for pretest scores through ANCOVA, a comparison of posttest scores showed that students' level of self-efficacy and process skills were significantly higher ($p < .05$) in the experimental group than in the control group. Students in the experimental group reported that their confidence and ability to think critically and analyze data improved significantly more than students in the control lectures/laboratories. This research further suggests that persistent professional development opportunities for faculty and graduate students are critical to the overall success of the course and curricular reform.

Edelson, Daniel C. **Session 6.13** **Saturday, March 22, 1997**
10:30am-12:00pm
York 1,2,3

Adapting Scientific Investigation Tools to Support Authentic Science Learning

Douglas Gordin **Roy D. Pea**

Current theories hold that authentic learning activities are a key to developing understanding that will serve learners beyond the classroom. Adapting the practices of science to classrooms can provide the benefits of authenticity for science learning. However, it is important to retain not just the tools and techniques, but the attitudes and social interactions that characterize science practice. Technology also plays an important role. In our research in adapting scientific visualization environments to support inquiry-based learning, we have identified five key aspects of successful design. They are: (1) **motivating contexts** where learners investigate issues that are personally meaningful to them and provide for suspense in the inquiry process, (2) **activities** which are active and constructive where learners participate in scientific discourse that engages and elaborates their understanding, (3) **data selection** such that learners access or collect data capable of bridging to the experiences of the learners and enable them to pose questions they find naturally interesting, (4) **tools and techniques** learners use to conduct their investigations which are appropriate to their level of understanding and their natural means of interaction, and (5) **learning resources** in the physical and computational environment that enable learners to develop increasingly sophisticated scientific understanding.

Edgington, Judith R. **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

What Constitutes a Scientific Explanation?

The purpose of this study was to investigate the nature of scientific explanations used in science education. Science educators agree with philosophers that explanation is the very purpose of science itself and explanation tasks are commonly used to assess students' understanding. However, little research is done on the nature of explanations given by individuals who have received formal science instruction. A review of the views on explanation expressed by philosophers, physicists, and science educators suggests that these groups not only hold different perspectives, but they are concerned with different aspects of the problem. Philosophical analyses highlight the pragmatic factors involved in explanations as well as their logical structure. Physicists view explanations as part of playing by the rules of the scientific domain which are very distinct from the rules used in everyday domains. Studies in the nature of explanation in science education stand on looser philosophical grounds. These studies are naturally interested in types of teaching explanations and in students' explanations which represent diverse groups of individuals with very different characteristics and in many different settings. Findings suggest that the potential in this area of research has yet to be recognized.

Eichinger, David C. **Session 13.07** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook III

Evaluating Computer Lab Modules for Large Biology Classes

Mary B. Nakhleh **Deanna Auberry**

This paper describes the first phase of a study to investigate students' evaluations of computer laboratory modules in a university-level, non-majors biology course. The NSF-funded project has two primary goals: (1) to develop programmable, multifunctional Bio LabStations for data collection and analysis, lab extensions, simulations, and student assessment, and (2) to implement, evaluate, revise, and finalize a series of laboratory exercises under actual classroom conditions. Field observations of the labs and student responses to a written survey administered at the end of the first year of the project indicate (1) strong preferences and dislikes for particular lab modules based on each module's perceived ease of use and the importance of the topic to the student, (2) a general approval of using computers in the lab because the computers are perceived to be a necessary component of modern science, and (3) the computer modules are helpful in understanding the lab because the students receive a strong visual/mental image of the experiment or simulation.

Eilam, Billie **Session 7.07** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency B

Changes in Classroom Conceptual Environment of a Food Chain

Miriam Reiner

This study deals with relations between changes in the individual's beliefs and classroom-distribution-beliefs, titled here classroom conceptual environment. Conceptual change is usually viewed as a personal process. We examine relations between individual conceptual change - a microscopic view, and total classroom conceptual change - a macroscopic view. Changes in individual's ideas of a food chain are studied. Underlying ontological beliefs that may explain students' ideas are identified. Changes in students' responses, prior to and following upon classroom instruction, are examined. Classroom concept of a food chain was found to reflect an underlying set of beliefs of a mechanistic nature. For instance, the metaphor of a bead chain is employed to explain the relations among elements of a food chain. Though more than half of the students changed their responses, ontological beliefs were hardly changed. Only a minor change was identified in the overall conceptual environment. Implications for instruction are discussed.

Ellis, James D. **Session 14.06** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency A

A Review of the NSF Portfolio of Comprehensive Instructional Materials

Janice Earle

The release of the National Science Education Standards compelled the National Science Foundation (NSF) to take stock of its portfolio of instructional materials in science. As a first step, NSF reviewed 19 comprehensive sets of instructional materials for middle school science. The purpose of the study was to answer two questions: (1) What are the characteristics of the NSF portfolio of comprehensive instructional materials for middle school science? (2) How sufficiently do these materials provide for a comprehensive program for middle school science consistent with national standards? Results of the study indicate that, while the portfolio does not contain much that could be viewed as "multi-year comprehensive," there are a number of high quality middle school science materials available and a few are comprehensive. With care, schools and districts can create a good middle school science program. The review instrument developed as part of the study will be distributed as a useful tool for use by those who wish to select materials for school science programs.

Enger, Sandra

Session 8.13

Saturday, March 22, 1997
1:00pm-2:30pm
York 1,2,3

Voices of Reform: Student Free-Response Performance on Items Developed from a Standardized Test

A set of free-response items was developed from a subset of multiple-choice items from the Iowa Tests of Educational Development (ITED). The subset was from the Analysis of Science Materials Test in order to make comparisons between student performance on the format variations. These free-response items were administered to 309 ninth grade students in a Midwestern high school. The free-response items included items in which the students were required to graph and interpret data, write conclusions, identify and control variables, and judge the validity of information. The free-response items were administered over two consecutive days during 50 minute class periods. A significant correlation of 0.622290 (p=0.000) between the total score on the free-response items and the raw score on the ITED was noted. Data from the free-response administration provides support for the diagnostic potential of the free-response format.

Escalada, Lawrence T.

Session 13.07

Sunday, March 23, 1997
2:30pm-3:30pm
Oak Brook III

"Solids & Light": An Instruction Unit that Introduces Quantum Principles by Using Light Emitting Diodes

Sanjay N. Rebello Heidi M. Gruner Dean A. Zollman

The Physics Education Research Group at Kansas State University has developed and evaluated instructional units for the *Visual Quantum Mechanics* project that utilize a few central concepts, hands-on activities, inexpensive devices, applications to physical phenomena, modern technology, written documents, and interactive computer programs to introduce quantum principles to high school and introductory physics college students with limited backgrounds in physics and mathematics. *Solids & Light*, the first unit to be developed, introduces quantum concepts as applied to a commonly encountered solid state device- the light emitting diode (LED). Beginning with no prior background in quantum physics, students perform a series of activities to learn how a model of a solid, which includes energy bands and energy gaps, can help them explain the spectral and electrical properties of an LED. This unit has been available for field test to high school and college physics teachers since March of 1996. Preliminary data have been collected from physics teachers who have implemented these materials in their classrooms. These field tests precede a more extensive evaluation that will occur in the fall of 1996. We present a brief description of the unit and the results of these preliminary field tests.

Falk, John H.

Session 14.03

Sunday, March 23, 1997
4:00pm-5:00pm
Oak Brook I

Investigating Long-Term Museum Learning: A Pilot Study

Lynn D. Dierking

A study was conducted to investigate the long-term learning resulting from visits to the Smithsonian Institution's National Museum of Natural History. A random sample of visitors were tracked throughout their visit, noting where they went, what they did and what they conversed about. An open- ended, post-visit interview was conducted to learn why they visited the museum, what they were interested in and what they felt was interesting and informative during the visit. Follow-up, open-ended interviews were conducted by telephone twice. Seventeen groups of visitors, 47 individuals, were identified, tracked and interviewed, then telephoned back, four to five months later and one year later. Data were analyzed in two ways: 1) patterns and trends in the data were identified utilizing correlational analysis and 2) case studies were developed for a subset of the visitors. Each of the individuals investigated revealed a range of learning. All individuals evidenced storage of images and information that they later related to events or individuals. Only parts of the events, objects, ideas and images that visitors experienced could be immediately recalled several months later. Prior interest and experience, as well as level of social interaction, played a role in what was recalled and learned.

Feldman, Allan **Session 6.04** **Saturday, March 22, 1997**
10:30am-12:00pm
Cermak

Teacher's Roles in the Development and Implementation of a Secondary Physics Curriculum: An Evaluation Study

This paper describes an ethnographic evaluation study of the development and implementation of a high school physics curriculum. The study focused on the actions, knowledge, and beliefs of the teachers involved in the project, the manner in which they negotiated curriculum with their students in their classes, and how they interacted with the physicists who made up the development team. It was found that teachers varied considerably in the ways that they implemented the curriculum, and that the variation did not depend simply on subject matter background or experience. It was also found that participation in the project had profound effects on the teachers independent of the degree in which they implemented the curriculum. Finally, it was determined that a significant impediment to implementation was differences between the development team's and teachers' educational theories, conceptions, and beliefs about the purposes of high school physics.

Fetters, Marcia K. **Session 3.09** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook IV

Moving from "Teachers should ..." to "I will ....": Making the Transition from Student to Teacher

In education courses and even during student teaching it is common to hear statements from pre-service teachers such as: "If this were my class I would never....." or "If schools would just...." By the time they are ready for student teaching most students can talk or write quite eloquently about the role of science in everyday life and why it is important for students to learn science. Pre-service teachers can talk quite authoritatively about what teachers or schools should be doing to support the needs of the student. Pre-service teachers are quite comfortable talking about what "They" (teachers) should do this dedication to teaching *all* students appears to waiver when confronted with activities that push them take ownership of the situation and propose alternative actions. This paper tells the stories of three pre-service teachers as they move through a science methods course, into student teaching and then into their first year of teaching. It follows them as they make the transition from "teachers should..." to "I will..."

Filkins, Kathleen **Session 9.05** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook III

Science Teachers of the Twentieth Century: An Intergenerational Oral History Project

Debra Heath

Historians recognize that to understand the present and the future, we must reflect upon the past. As science educators, it is important that we consider practices and experiences of colleagues that have preceded us. Oral history projects are an innovation inspired by teachers. And yet, histories of classroom teachers in our schools, including those of science teachers, have been overlooked in such histories. This study combines data collected by science teachers working through their state science association and preservice education students. Emerging stories from completed interviews prompted rich reflection by interviewers. This reflection promoted personal growth, respect for the profession, and the realization, that, despite challenges facing science educators, individual classroom efforts continue to be valuable. The data collection became meaningful as students and teachers reflected upon similarities and differences between science coursework and practices past and present. In the listening and retelling of stories, past classroom experiences were honored. This project provided a bridge between science teachers across time and helps us look at our profession from a more coherent perspective.

BEST COPY AVAILABLE

Fisher, Darrell **Session 12.07** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook II

Laboratory Learning Environments and Practical Tasks in Senior Secondary Science Classes

Allan Harrison **David Henderson** **Avi Hofstein**

Laboratory work is seen as an integral part of most science courses; however, a significant proportion of laboratory activities remain highly prescriptive and fail to challenge secondary science students. This unique study of senior high school biology, chemistry and physics laboratory environments drew data from student responses to the *Science Laboratory Environment Inventory* (SLEI) and a curriculum analysis of the implemented laboratory tasks. The study involved 387 biology, chemistry and physics students in 20 classes in Tasmania, Australia. The curriculum analysis was based on Lunetta and Tamir's *Laboratory structure and task inventory* and the *Laboratory task analysis*. The study found that the SLEI has the capacity to consistently identify open-endedness, rule clarity and content integration in student laboratory activities. The use of open-ended, student planned investigations appears to enhance student interest in laboratory activities.

Fishman, Barry J. **Session 16.06** **Monday, March 24, 1997**
8:30am-10:00am
Regency C

The CoVis Project: A National Testbed for Science Learning Reform

Louis Gomez **Roy Pea** **Daniel Edelson** **Eileen Lento**
Laura D'Amico **Douglas Gordin** **Kevin O'Neill** **Joseph Polman**
Greg Shrader **Judith Lachance-Whitcomb** **Rory Wagner**

This session will introduce the research and activities of the Learning Through Collaborative Visualization (CoVis) Project. CoVis is an NSF-funded effort to improve science education through project-enhanced learning and links to authentic communities of science practice using high-technology communication and collaboration tools. Currently in its fifth year, CoVis works with hundreds of teachers at over 45 schools. After a brief orientation to the goals and structure of the CoVis Project, audience members are invited to explore eight separate posters and computer demonstrations. Topics are: student and teacher use of communication technologies that include e-mail, shared multimedia notebooks, and videoconferencing; the design and use of scientific visualization tools; the development of resources for on-line mentoring; alternative assessment practices for project-based teaching; student appropriation of inquiry-based learning; the development of activities to foster collaboration; teacher professional development; and formative results of testbed research.

Flick, Lawrence **Session 6.06** **Saturday, March 22, 1997**
10:30am-12:00pm
Hunt 1,2,3

Teacher Intentions, Teaching Practice, and Student Perception of Inquiry Oriented Teaching

Valarie L. Dickinson

This study took a holistic perspective of inquiry teaching by examining the alignment between major components of instructional dynamics. The first part of the study examined alignment between teacher intentions for instruction and classroom teaching practices. The second part of the study examined alignment between teaching practices and student perceptions of teaching practice. Four middle level teachers were selected from participants in an NSF program presenting constructivist and inquiry-oriented teaching practices and selected science content. Teacher interviews and interviews of a sample of students from each classroom were analyzed using a form of semiotic analysis. Direct classroom observations and video taped records of a unit of instruction were used to assess the alignment of teacher intentions, teaching practice, and student perceptions of inquiry-oriented teaching. Results revealed a wide variation in teacher understanding of recommended practices. There was general agreement concerning intentions for teaching strategies designed to support inquiry. Student content knowledge and understanding of the nature of science interacted with their perceptions of teacher intentions. An implication is that the ways teachers communicate their intentions for higher order thinking during inquiry-oriented instruction is not adequately captured by current representations of recommended teaching practices.

Flick, Lawrence B. **Session 8.04** **Saturday, March 22, 1997**
1:00pm-2:30pm
Oak Brook I

Perspectives on Inquiry-Oriented Teaching Practice

Carolyn Keys **Susan Westbrook** **Barbara Crawford** **Nathan Carnes**

The purpose of this interactive session will be for participants to each state a finely drawn position on the nature of successful inquiry teaching practice applied to middle and high school classrooms. The resulting diversity of views will offer an opportunity to explore state of our knowledge concerning inquiry-oriented teaching. All panel members have conducted research that includes the direct observation of teachers and analyzed teaching practice from an inquiry perspective. Despite the intense reform rhetoric around inquiry-oriented teaching, the literature is inconsistent and often strangely silent about the actions of teachers engaged in inquiry-oriented instruction. Panel members represent experienced as well as new researchers who together represent a diversity of views on inquiry teaching with pre-adolescent and adolescent students.3-3.1

Foley, Kathy **Session 12.06** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook I

A Teacher Immersed in Scientific Research: Its Influence on Her Teaching

A middle school teacher learned not only science content but also about the culture of science by immersing herself in research at a marine laboratory near her school. The objective of the research was to videotape crustaceans and compare the antennules housing the aesthetascs (i.e., the olfaction system). The crustaceans included the blue crab, sand fiddler crab, marsh fiddler crab and a deep water crab, all collected near to the teacher's school. Measurements were made of the aesthetascs using a dissecting microscope and a macro lens. The results of the project include a videotape comparing the antennules of the crustaceans. The results also include the impact the project has had on the teacher, i.e., the technical skills developed, the knowledge of community resources and of crustacean sexual biology and morphology. The teacher also engaged in rich conversations with scientists who promoted the use of research in the classroom by providing methods of obtaining animals, management of the animals and projects for study by the students.

Ford, Danielle Joan **Session 4.03** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Science Programs on Television: Issues of Authenticity and Inclusiveness

Science television programs used in classrooms can potentially bring to students positive images of science that they may not usually have opportunities to experience, and can also imagine a scientific community more gender and ethnically inclusive. But do television science programs fulfill this potential? Twelve episodes of the adult science programs *NOVA* and *National Geographic* and the children's programs *Bill Nye the Science Guy* and *Beakman's World* were analyzed for images of science and scientists, with particular concern for the underlying nature of science portrayed, the equity of the images presented, and the authenticity of the representation of the scientific community. Results of this analysis indicate that although some of the children's programs portray children of many ethnicities and genders engaged in fun, meaningful science, the experiments that they perform are often done alone, and often merely school science confirmations of factual information. The adult science programs portray significantly fewer women and people of color in authoritative science positions, and show little of the community aspects of the scientific enterprise. None of these popular shows portray a non-traditional view of the nature and origin of scientific knowledge.

Foster, Andrea

Session 10.12

Saturday, March 22, 1997
4:00pm-5:30pm
Regency F

Religion and Science Education: Arguments in the Special Issue of *Science and Education*

Cathleen C. Loving John Staver William W. Cobern

In 1996 a special issue of the journal *Science and Education* (vol.5 no.2) was devoted to the theme of 'Religion and Science Education' with a lead article by the biologist Martin Mahner and philosopher Mario Bunge arguing for the incompatibility of science and religion on doctrinal, metaphysical, methodological and attitudinal grounds, and concluding that religious education was an impediment to the development of scientific mentality and attitudes. Their argument was responded to by six commentators (two philosophers, two science educators, a scientist, and a theologian). The questions dealt with by the contributors to the special issue ranged over metaphysics, ontology, epistemology, theology, foundations of education, the history of ideas, and the purposes of science education ñ they are basic and perennial questions that in one form or another engage most thoughtful people. Participants in this symposium will examine some of the arguments in the special issue, and two of them (Cathleen Loving and John Staver) will report on graduate student responses to reading and discussing the issue. The symposium will encourage readers of the special issue (which was overprinted and widely distributed) to voice their own responses to the arguments.

Foster, Andrea

Session 8.03

Saturday, March 22, 1997
1:00pm-2:30pm
Kent 1,2,3

Elementary Science Presidential Awardee Teacher Interviews

The objective of this naturalistic study was to determine what kinds of experiences have contributed to exceptional science practices in these six elementary teachers' classrooms. This paper presents the results of analyzing data collected from in-depth interviews of six Texas elementary science Presidential Awardees. Interview questions focused on career history, descriptions, attitudes regarding excellence in teaching, and any significant life events or particular individuals that may have impacted their professional careers. A content analysis of interview data revealed a number of categories including Significant History; Mentorships, Collaborators and Networks; Personal Characteristics; Pre-Service Preparation; Powerful Inservice Experiences; Teaching, Learning and Curriculum; and Perceived Barriers to the Teaching of Science.

Fraser, Barry

Session 8.10

Saturday, March 22, 1997
1:00pm-2:30pm
Regency D

Progress and Prospect in Research on Science Learning Environments

This paper identifies historical landmarks in the development of the field of learning environments over the past 30 years, important contemporary programs of research, and desirable future directions for research. The paper includes discussion of (1) the historic evaluation of Harvard Project Physics, (2) the development of specific-purpose assessment instruments such as the *Science Laboratory Environment Inventory* and the *Constructivist Learning Environment Survey*, (3) the use of qualitative methods in learning environment research, including the combination of quantitative and qualitative methods, (4) the development of preferred forms of instruments which permit investigations of differences between actual and preferred classroom environments and person-environment fit studies of whether students achieve better in their preferred classroom environment, (5) teachers' use of assessments of actual and preferred classroom environment in action research attempts to improve their classrooms, (6) incorporation of learning environment ideas into teacher education and school psychology, and (7) the idea of 'grain sizes' in learning environment research.

Fraser-Abder, Pamela **Session 17.10** **Monday, March 24, 1997**
10:30am-12:00pm
Regency D

Preparing Teachers to Teach in Multi-Cultural Communities

The purpose of this project was to assist teachers in developing an awareness of the gender, cultural and psychosocial factors which affect science teaching and learning, and, in identifying and finding solutions to the complex educational problems they face in their science classrooms. The end-product was the creation of innovative, effective and culturally relevant curricula and pedagogy for students in a multi-cultural setting. The program focused on developing an awareness of specific ethnic and gender issues in the school system and the community, as they relate to the participation of women and ethnically diverse students in science and mathematics, with specific emphasis on classroom based research conducted with their own students. As an integral part of the program teachers developed intervention strategies for improving achievement in science and math in their individual classrooms. The 24 science and mathematics teachers who participated received 45 hours of training during the academic year and then worked with students at a summer camp for six weeks. Evaluation of their awareness of gender and cultural issues as measured by interviews, autobiographies and observation of their teaching indicated significant increases.

Fraser-Abder, Pamela **Session 7.05** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook IV

Building Knowledge Through Informal Contexts: A Teacher Education Model

This paper examines the use of the informal arena as an avenue for developing scientific knowledge and attitudes.. As part of the development a national survey to determine the need for training in informal science education, the availability of current and future jobs in the area and the required components of a graduate program in Informal Science Education as perceived by personnel presently involved in Informal Science was conducted. The paper describes the results of the survey and the resultant science teacher education model developed to address the needs expressed in the survey. The results of the survey support the claim about the increase in the number of sites for informal science education, future jobs and the immense need for training by personnel in the science education sector. The program bridges the formal and non-formal non-intersecting systems to provide students with access to science and technology and an understanding of their influence on our daily lives thereby making some inroads in achieving scientific and technological literacy for all.

Freedman, Robin Lee Harris **Session 6.05** **Saturday, March 22, 1997**
10:30am-12:00pm
Harger

GER Students' Perspectives of Assessment Practices

Student's perceptions about assessment practices were investigated through the use of a Q-sort. Participants were undergraduate non-science majors in a General Education Requirement natural science core course. Q-Methodology identified two distinct profiles, Teacher-Centered and Student-Centered. These profiles indicated ideal student perceptions of course assessments. The two profiles indicated a difference in the amount of input students would like to have into the (1) types of assessments that should be used to grade them, (2) what kinds of feedback students want from teachers, and (3) how assessment is used to set up expectations in the classroom.

Freedman, Robin Lee Harris **Session 8.13** **Saturday, March 22, 1997**
1:00pm-2:30pm
York 1,2,3

Voices of Reform: Student and Teachers on Assessment in the Classroom

Matthew S. Beisel

This study examines relationships and interactions between student and teacher perceptions of alternative assessments used during the school year. As part of a major reform project in the Midwest, teacher participants in a special assessment program were observed and interviewed concerning their assessment practices. Randomly selected students from the teachers' classes were also interviewed. Teacher observations and interviews focused on teachers' classroom assessment practices. Student interviews focused on students perceptions of classroom assessments. Comparisons revealed that a variety of assessment practices were used to assess knowledge and competency as stated by the National Science Education Standards. In general students preferred the performance based over standardized text embedded assessments they experience in other classrooms.

French, Jenice **Session 4.01** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Case Studies of Empowerment and Development: Preservice Elementary Teachers Talk About Science and Science Teaching

Laura Downey

The purpose of this longitudinal qualitative inquiry is to describe preservice elementary teachers' self reflections upon their preparation and journey into science teaching framed by their historiographies and recent experiences within a nontraditional science methods course where empowering strategies were implemented. The study followed 4 preservice elementary teachers Ç through their professional development courses, student teaching, and their teaching experiences upon graduation. Qualitative data for this study included: historiographies, audio taped structured interviews, audio taped semi-structured interviews, video tapes of classroom interactions, and field observations. The data was analyzed contextually using constant comparative methodology. The case studies revealed the participants' perceptions of their science preparation, their views of empowerment, as well as their perceptions of what influences and shapes the choices and actions that they take in their professional roles.

Gabel, Dorothy L. **Session 8.07** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency A

Improving Chemistry Achievement of Young Women Using a Multi-Dimensional Conceptual Approach

Diane M. Bunce

Twelve high school chemistry teachers involved in a team action research project tested the hypothesis that teaching chemistry by integrating the macroscopic, particulate, and symbolic levels of representing matter is more effective than teaching in the more conventional manner that emphasizes the symbolic representation. Teachers developed three two-week units of instruction and designed three tests containing six items on each level to measure students' conceptual understanding of the states of matter, solutions and bonding, and stoichiometry. The treatment was randomly assigned to one experimental and one control class of each teacher and the tests were administered immediately following instruction. Data from the 12 treatment and control groups were analyzed using an analyses of covariance with GALT and the SAP test as covariates. Although the treatment group scored consistently higher than the control group, most differences were not statistically significant. However, when data were analyzed according to gender, the analyses indicated that young women's scores in the treatment group were significantly higher than those in the control group with mean scores approximately equal to those of the young men. Hence, the results of the study indicate that the approach is beneficial for young women.

Gansneder, Bruce **Session 17.14** **Monday, March 24, 1997**
10:30am-12:00pm
York 1,2,3

Development and Testing of a Suite of Instruments for Assessing the Impact of Research-Oriented Science Teaching

Debra Hemler **Aimee Barden**

This paper details the development and testing of instruments that assess the impact of the Research Experiences in Teacher Preparation (RETP) project, a series of institutes for inservice and preservice teachers at the National Radio Astronomy Observatory (NRAO). The aim of the RETP Institute was to advance participants' understanding of the nature of science. To determine if changes occurred in teachers and their students, 5 instruments were developed: (1) *Research Self Assessment* (RSA): assessing teachers' perceptions of their ability to conduct research, (2) *Institute Evaluation* (IE): gauging teachers perceptions of three aspects of the institute, (3) *Implementation of Research Project* (IRP): measuring teachers' concerns about implementing classroom research problems (4) *Student Attitude Toward Science* (SATS): with which students' perception of science and science class are determined, and (5) *Nature of Science and Science Teaching* (NSST): which tests teachers' perceptions of the way that science works. Trials were conducted with comparison groups of science teachers in West Virginia and institute participants. Measures of internal consistency were calculated, and items with low reliability were reworded or abandoned. The nature of these instruments makes them useful in the evaluation of this project and as research tools for identifying effects in other programs.

Gardiner, Peter **Session 12.12** **Sunday, March 23, 1997**
10:30am-12:00pm
York 1,2,3

Biology Laboratory Investigations in British Columbia High Schools and their Effect on Provincial Examination Scores

The purposes of this research were to survey the quantity and quality of laboratory work conducted by Grade 11 and 12 Biology students in British Columbia High Schools, to analyze laboratory based questions and student performance on Provincial examinations and examine the curriculum for recommended laboratory work. A pilot survey produced a valid survey instrument. Examination and curriculum data were extracted from Ministry documents. Survey data generated statistics on school demographics, teachers, laboratory work, use of technology and constraints of the provincial curriculum and examination. The frequency of lab work was low, with quantitative labs lower than qualitative, and most labs confirmatory rather than investigative. Critical thinking and formulating hypotheses occurred rarely. Most teachers indicated that lab simulations and computer data collection were rarely or never used. Although laboratories are equipped adequately, the curriculum and provincial examination limit the scope for an inquiry course. Lab work had no effect on lab question scores on examinations. Less lab work than was documented and recommended in the syllabus is conducted. This study demonstrates that while the current philosophy of teaching science is a constructivist, "hands on, minds on" authentic learning experience, little change in classroom practice has occurred.

Gaskell, Jim **Session 14.12** **Sunday, March 23, 1997**
4:00pm-5:00pm
York 1,2,3

Work, Schoolwork, Networks: Linking Partners and Courses in Applied Science

This study examines how an applied science course developed differently in two different contexts even though it was based on the same set of materials. In one community context, typified by the close involvement of business, labour and post-secondary partners, the grade 11 applied physics course was a significant departure in content and organization from existing physics courses and made frequent references to particular jobs, processes and people in local industry. In a second community context typified by the loose involvement of business, labour and post-secondary partners, the same grade 11 applied physics course retained the significant features of the existing physics course and made few references to local industrial applications. Data are drawn from classroom observations, policy documents and interviews with key players. The analysis will drawn on actor-network theory as developed by Callon, Latour and Nespor to show the simultaneous construction of networks of support and particular versions of courses through the linking and translation of interests. The analysis has implications for recent efforts to incorporate a more occupational focus to academic curriculum.

Gattis, Kenneth W. **Session 12.10** **Sunday, March 23, 1997**
10:30am-12:00pm
Ogden

Effectiveness of Demonstrations in Facilitating Physics Concept Acquistion

Park, John C.

The objective was to determine if certain physics topics and types of concepts are more amenable to conceptual change through the use of demonstrations than through the use of other instructional methods. The demonstration treatment was assigned to two sections of college physics and the control to a third section. Observations were made on three different topics, which were chosen to differ in both the nature of the concepts and the expected amount of prior exposure to them by students. Short conceptual quizzes were given to all three sections at the beginning and at the end of classes, and a sample of students from each class was interviewed. Results indicated that the concept of forces on an object moving at constant speed on a frictionless surface was fostered better by demonstrations. Students seeing example problems explained the concept of changes in rotational motion due to changes in moment of inertia better than students in the demonstration sections, however there was no difference in prediction ability.

Gebhardt, Corinna **Session 3.07** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook II

Students' conceptions of Genetechnology and Consequences for Moral Development

Horst Bayrhuber

The aim of this research project was to find out if the moral judgement concerning genetechnology could be improved by the implementation of teaching material which considers students` preconceptions of genetechnology. For this purpose, firstly, 12 secondary school students were interviewed by qualitative face-to-face interviews to investigate their moral judgement. Secondly, the preconceptions concerning genetechnology were investigated by a questionnaire considering the cognitive structures of preconceptions. These interviews and questionnaires were designed as qualitative tools. Based on the investigated preconceptions of this pilot study teaching material was developed and implemented in a secondary school experimental group. In addition a control group was taught using conventional teaching material for genetechnology. The evaluation of both groups consisted of a pretest and a posttest. The evaluation results revealed the qualitative trend that the experimental group students intensified their moral judgement much more so than the students of the control group. These research results indicate that the moral judgement can be improved by teaching when students' conceptions are taken into consideration.

Geelan, David **Session 9.13** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency E

Weaving Narrative Nets to Capture School Science Classrooms

This study employs a narrative methodology to explore richly represented classroom contexts and events during the implementation of some teaching innovations. These grew out of the author's earlier research into the use of constructivist teaching approaches in secondary school science classrooms. Constraints to changes in educational practices are seen as arising in both the institutional structures of schooling and the webs of role expectations and practices held by both teachers and students. The danger and irony implicit in the unilateral introduction by teachers of innovations intended to empower students is discussed. This paper is intended to speak richly to other teachers - perhaps engaged in similar innovations - of the struggles, critical reflections and triumphs involved in attempting to improve the equity, relevance and power of one's teaching practices.

Geelan, David **Session 17.11** **Monday, March 24, 1997**
10:30am-12:00pm
Regency E

Impressionistic Tales, Surrealistic Tales: Exploring Critical Classroom Events Through Fictionalised Stories

This study grew out of my own teaching. It was intended to explore the impulses leading toward violence that teachers feel, and why some teachers might give in while others resist. In an impressionistic tale, I recorded an incident in which a colleague struck a child and explored reflectively my own reactions and responses to that incident. From an initial position where I considered myself virtuous and the colleague evil, I later came to recognise within myself similar tendencies. In a subsequent surrealistic tale, I wrote as though I had acted out my own impulses of violence toward a student. Although this tale is not 'true' in the sense of my violence happening in the school, it DID happen in my mind. In this paper, I argue that a self-study of teaching methodology that uses impressionistic tales is powerful because it allows the teacher-researcher to address difficult moral questions in richly contextualised ways.

Gerber, Brian L. **Session 12.03** **Sunday, March 23, 1997**
10:30am-12:00pm
Harger

Relationships Among Informal Learning Environments, Teaching Procedures and Scientific Reasoning Ability

Ann M. L. Cavallo Edmund A. Marek

This study of middle school and high school students (N = 505) used the independent variables of informal learning environment (impoverished or enriched) and science classroom teaching procedure (non-inquiry and inquiry) to explore possible differences in the dependent variable of scientific reasoning ability. The purposes o £f this study were to 1) investigate possible differences in students' scientific reasoning abilities relative to informal learning environments, classroom teaching procedures and/or the interaction of these variables, and 2) examine possible differences in reasoning abilities relative to informal learning environments, classroom teaching procedures and the interaction of these variables among students within different grade levels. The results of two-way ANOVAs indicated that informal learning environments and classroom teaching procedures produced significant main effects on scientific reasoning abilities. Interactions revealed a tendency for scientific reasoning abilities to increase with enriched informal learning environments and inquiry teaching procedures. The results indicated unique relationship patterns in informal learning environments and teaching procedures among students within different grade levels.

Germann, Paul J. **Session 16.02** **Monday, March 24, 1997**
8:30am-10:00am
Kent 1,2,3

The Use of Science Processes in Secondary Science Laboratories: A Comparison Between Veteran and Non-Veteran Missouri Science Teachers

Lloyd H. Barrow

This study focused on how veteran and non-veteran Missouri science teachers use the laboratory to teach scientific inquiry. Sixty-four percent of 1000 randomly chosen science teachers to receive surveys responded to items concerning (a) the amount of class time used for laboratory activities; (b) the types of activities they used to present scientific phenomena to students; (c) their reasons for engaging students in laboratory work; (d) the frequency that students engaged in laboratory investigations designed to develop science process skills; and (e) the degree of self-efficacy teachers have in teaching inquiry skills. Respondents indicated that they use the laboratory primarily to develop thinking skills, demonstrate concepts and principles, and develop science process skills. Nearly all science teachers demonstrate phenomena to their students; lower percentages of teachers have students follow directions from a laboratory manual, informally explore phenomena, design and carry out experiments with the teacher's guidance, or carry out experiments independently. Most do not devote at least 40% of class time to laboratory investigations as recommended by the National Science Teachers Association (1993). There were significant differences between veteran and non-veteran teachers with respect to the science process skills addressed during laboratory activities as well as their confidence in teaching the identification of variables, creating experimental designs, and designing tables.

Gess-Newsome, Julie **Session 17.05** **Monday, March 24, 1997**
10:30am-12:00pm
Kent 1,2,3

Effects of Elementary Science Methods Course on Preservice Teachers' Understanding of the Nature of Science

Richard L. Statler Sherry A. Southerland

This study was designed to explore changes in preservice elementary teachers understanding of the nature of science (NOS). The forty participants spent 10-weeks in methods class exploring current issues and methods in science education and practiced planning and teaching inquiry-based science lessons, followed by an 8-week student teaching experience. The Nature of Science Knowledge Scale (NSKS) was given before, after methods, and following student teaching. Weekly journal writings, videotape and fieldnotes from methods classes were collected. During student teaching, four students were interviewed, observed and videotaped teaching science. Interviews following the program revealed additional insights about specific events that contributed to changing understandings of NOS and supported NSKS results. Open- ended instruments provided additional information such as changes in their definition of science (product, process and a way of knowing). Results indicate that preservice teachers conceptions of nos can be positively impacted by elementary science methods courses and these changes appear to remain stable throughout student teaching. Additionally, pairing of open-ended and quantitative instruments provided richer descriptions of students' conceptions and allowed us to track specific course activities that helped impact student conceptions.

Gibson, Elizabeth **Session 12.08** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook III

Student Attitudes Toward Science in a Grade-5 Integrated Learning Environment

Maureen McMahon

A three year collaborative research project, involving university researchers and a group of 5th grade teachers, is looking at the effects of (1) an integrated curriculum and (2) technology, on teaching effectiveness and various student attitudes. Examination of the attitudes of grade 5 students towards science, a sub-study of the larger investigation, has been concluded and is the subject of this proposal. Two findings are presented: (1) The results of a group survey of two years of 125 grade 5 students' attitudes towards science; and (2) a case study examining the primary factors responsible for the belief system and resultant attitude towards science, using Ajzen's Theory of Planned Behavior. The group survey reports on the overall student attitudes towards science for students who did not receive any integrated curriculum, and those who received two, two week units of integrated curriculum instruction, focusing on the Putah Creek Watershed - an integral part of their community and economy. The selected student case study is of a student who defines himself as one who hates" science and is proud of this fact. The results are analyzed according to Ajzen's Theory of Planned Behavior.

Giddings, Geoff **Session 12.11** **Sunday, March 23, 1997**
10:30am-12:00pm
Windsor

Multicultural Learning Environments: Influence of Culture on Science Learning

Bruce Waldrip

The study reported here is concerned with the cultural and ethnic backgrounds of students and how such cultural and contextual factors might interact with student perceptions of their learning environment and their preferred instructional mode. The study is relatively unusual in the field of classroom environment research because it combines both quantitative and qualitative methods. The first phase involved the development of instruments designed to measure aspects of a student's cultural expectations and classroom environment, the Multicultural Classroom Learning Environment Inventory (MCLE). Following a pilot study to help validate the instruments, the second phase of the project involved the instruments being administered to a comprehensive sample of approximately 2200 students from 100 science classes at the lower secondary school level (spread approximately equally between Years 8 and 9, each in a different school). The study confirmed the validity and reliability of the MCLEI scales and items in multicultural classroom settings. In particular, students who indicated a strong congruence between the school approach to learning in science and their own cultural approaches, saw their preferred classroom environment as being one which is characterised by higher affiliation, involvement, teacher support and task orientation.

Gilmer, Penny J. **Session 12.06** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook I

Teachers Learning Science by Doing Science

Four middle school teachers in a doctoral cohort group in science education have participated in four different scientific research projects during the summer. The idea is to immerse the teachers in scientific research, so that the teachers will experience the process of science first hand. As the teachers understand the scientific process, they begin to teach science to middle school students in a more authentic and engaging way. Preliminary results suggest that their students are more involved in learning science. The interactions between the teachers and the scientists are powerful forces in this change. Both sets of professionals grow and change from the experience. The teachers have all chosen to work with scientists who work near their school site, so that the collaboration with the scientists and their laboratory might continue and include the teacher and her students. Previously, these teachers had participated in scientific research when they had enrolled in a master's degree program in science education at the same university, but it was done near the university instead of near their school. It appears that having the research done near the school encourages continued collaboration. The research topic may interest the students more because it is relevant to their geographical region.

Graeber, Wolfgang **Session 17.01** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook II

The Relevance of Science Literacy

Claus Bolte
Jürgen Baumert
H. Jürgen Becker
Wolfgang Bunder
George E. DeBoer
Reinhard Demuth
Robert H. Evans
James J. Gallagher
J. Dudley Herron
John Holman
Thomas R. Koballa
Olaf Koller
Jon D. Miller
Jürgen Oelkers
Susan Paik
John Ramsey
Svein Sjoberg
Sylvia Ware

What role should the sciences play in our citizens' general education? Our living environment and reality are being increasingly influenced by human activity and scientific-technological applications. Many citizens feel that their lives are becoming more and more complex, disorganized, and thus incomprehensible, while at the same time they are being asked to engage in social and political decision-making that has long-term and global implications. Helping citizens become scientifically literate, which will enable them to engage in social and political decision-making, should be the centerpiece of formal education. Since deficient public understanding of science is a world-wide concern, the IPN organized an International Symposium or Scientific Literacy in Fall 1996. This session is an opportunity to continue and expand the conversation begun at this international symposium. Discussion will focus on the following questions: Do present instructional practices correspond with the demands of a technological age? How can scientific literacy be defined for all citizens? How can science instruction contribute to the development of scientifically literate citizens? What science content and skills should be taught and what instructional approaches should be utilized to develop scientifically literate citizens? How should teacher education programs be designed to prepare future teachers for the demands of teaching to achieve scientific literacy?

Greenwood, Anita **Session 16.03** **Monday, March 24, 1997**
8:30am-10:00am
Oak Brook I

Examining Elementary Teachers' Explanations of Their Science Content Knowledge

Michelle Scribner-MacLean

This study examines the science content knowledge of twenty- five elementary teachers who participated in the first phase of a research program beginning with a summer science institute. A pretest-posttest design was used, with participants answering ten questions related to light, temperature, internal energy and heat flow. Participants were also required to give an explanation for each response. Although participantsí pretest answers showed general agreement with the established science ideas, their explanations indicated that they had little or no understanding of the concepts. The posttest explanations showed moderate gains in understanding, but clearly some teachers were left in a state of cognitive dissonance. The institute used pedagogically sound strategies for probing understanding, raising and investigating questions, examining the ideas held in the scientific community and reviewing learning, and was highly acclaimed by participants. The study indicates that gains made in understanding science concepts is incremental rather than radical and that inservice programs must be designed to provide on-going support for teachers as they struggle to resolve their dissonance.

Gustafson, Brenda **Session 6.10** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook IV

Elementary Children's Technological Problem Solving: Selecting an Initial Course of Action

Patricia Rowel

The purpose of this study was to explore elementary children's (ages 6-12) conceptions of technological problem solving prior to formal classroom instruction in design and make tasks. Specifically, the study centered on 334 children's conceptions of how they would commence problem solving and the rationale they provided to support this initial course of action. Children's ideas were collected on an *Awareness of Technology Survey* and grouped to show trends in the children's thinking. Results showed that children's existing ideas about technological practice played a critical role in selecting a starting point for problem solving.

Guy, Mark **Session 17.04** **Monday, March 24, 1997**
10:30am-12:00pm
Hunt 1,2,3

Performance Assessment with Preservice Elementary Teachers: Does it Measure Up?

Jacki Wilcox

The purpose of this study was to document the implementation of a pedagogically-oriented performance assessment component within an elementary science methods course from the perspectives of the preservice teachers and the course instructors. The focus of the assessment task was on the teachers' pedagogical thinking about science inquiry rather than their science background knowledge or their ability to conduct a scientific experiment. Fifty-six elementary education majors participated in a performance task which assessed their ability to develop science inquiry activities using everyday materials. The performance task description, selected science topic, and scoring rubric were given to the preservice teachers ahead of time for their review. Implementing a pedagogically-oriented performance assessment experience was found to be a rewarding experience for both preservice teachers and instructors. Preservice teachers had the opportunity to articulate and demonstrate their thinking about teaching inquiry science in a performance setting. Instructors were afforded an additional assessment strategy for evaluating their students and gained insights into the effectiveness of their own teaching through the students' performances.

Hahn, Lori **Session 12.06** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook I

A Science Teacher's Contextual Learning Experience: Conducting Environmental Research

One of the most enriching experiences a teacher can partake is that of a contextual learning situation. This experience provides the teacher with direct contact with a professional in his/her field. Such a contextual learning opportunity led me to science research on marine toxins at the Environmental Protection Agency. Working with a research scientist provides the teacher with a first hand glimpse of the culture of science and a chance to immerse his/herself in an actual scientific investigation. After experiencing this type of learning, the teacher can then extrapolate similar learning situations to his/her own classroom.The simple act of working in a research laboratory is empowering. This empowerment is one you do not get by reading about the research of others. This experience led me to focus my own dissertation research using contextual learning with students and the issue of empowerment. Although, I have only recently begun to look at this approach in an interpretive vein, I have long held the belief that students learn more when they are physically involved in a productive effort which has purpose and meaning.

Hairston, Rosalina **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

On Becoming a Constructivist Biology Teacher

The purpose of this study was to analyze the science teaching practices of biology teachers who attended an institute where constructivist perspective was introduced and practiced. Nine teachers were observed and video taped teaching cell and molecular biology. Two instruments in the ESTEEM model were used, namely: the Science Classroom Observation Rubric helped to analyze the teaching practices and the Student Outcome Assessment Rubric provided student feedback related to the main idea, inquiry, and relevance of the lesson. Three raters (interrater reliability .87) evaluated the teachers and scored the lesson. The ratings revealed that all teachers scored high on facilitating the learning process from a constructivist perspective. However, several teachers were unable to vary their methods of instruction (44%) and to help students resolve their misperceptions (53%). The Student Outcome Assessment Rubric revealed that 33 percent of the teachers successfully conveyed the main idea of the lesson, 67 percent of the classes asked abstract questions and found the lesson relevant to themselves and 22 percent stated that the lesson was important to society. The teachers unanimously agreed that their transformation into a constructivist teacher is a challenging process.

Hammond, Lorie **Session 3.02** **Friday, March 21, 1997**
7:00pm-8:30pm
Butterfield

BICOMP Science: A Sheltered Constructivist Model of School Change

Barbara Merino

This case study traces the development of a successful science-centered integrated curriculum project for language minority students and considers factors which have made this project portable or not portable to various secondary settings. The Bilingual Integrated Curriculum Project, known as BICOMP, developed over an eight year period as a teacher research project focused on creating a constructivist elementary science-centered integrated curriculum at which English language learners could succeed and excel. Collaboration between University of California researchers and bilingual teachers in Washington Unified School District resulted in a set of k-5 bilingual curricula and a methodology, which was named "sheltered constructivism", which proved successful with Spanish bilingual and, later, multilingual populations. In 1991, BICOMP received a Title VII Academic Excellence dissemination grant for the purpose of reproducing the project in other school settings. This case study evaluates the elements which made BICOMP successful in its home district, as these have been researched in relation to dissemination experiences in seventeen schools and three university pre-service programs. It suggests a consistent set of factors and approaches which make both school reform and project replication possible, as well as factors which block such reform.

Hammrich, Penny L. **Session 12.04** **Sunday, March 23, 1997**
10:30am-12:00pm
Hunt 1,2,3

Teaching for Excellence: Using Project 2061 Benchmarks for More Effective Science Instruction

Kerri L. Armstrong

In this presentation, I describe a model for utilizing national science reform initiatives in an elementary science methods course. By focusing particularly on Project 2061 benchmarks, the reform movement initiated by the American Association for the Advancement of Science, teacher candidates were able to successfully analyze, integrate, and utilize both "content and pedagogy" into the design of lessons and curriculum. This background provided teacher candidates with the skills and knowledge to incorporate the benchmarks in the development and implementation of teaching elementary science. Teacher candidates were also invited to lead and facilitate an in-service program showing elementary teachers how to incorporate the benchmarks in their science classes. The teacher candidates' reflections revealed support for the use of this model in demonstrating the importance of the benchmarks in promoting scientific literacy for moth students and teachers.

Hammrich, Penny L. **Session 6.03** **Saturday, March 22, 1997**
10:30am-12:00pm
Spring Room

The Resilience of Girls in Science: A Model Project

The model project addressed three areas: (a) increasing girls attitudes, interest, and aptitude in science; (b) creating a more positive learning climate; and (c) increasing the knowledge base and understanding of intergenerational partnerships. The overall design was built upon an intergenerational focus. Sample population included sixty 4th grade girls in two urban elementary schools. The goals were achieved through four components: (1) classroom activities; (2) after-school activities; (3) summer activities; and (4) family activities. Findings indicate that teachers increased their awareness of gender equity. Seventy-five percent of the parents became more active in their daughters science activities. There was also a 95% attendance rate by the girls in the after-school program and a 65% attendance rate in the summer program. Qualitative data showed that the fourth grade girls became more assertive in the classroom, increased their interest in science, and attained better academic self-confidence. The data also showed that science process and language skill development increased. Quantitative data showed that the girls' scores on the Philadelphia science assessment test increased by 53%. Other data showed that the girls increased their skill development in science by 65% from the pre-assessment.

Hand, Brian **Session 7.11** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency F

Developing a Model to Enhance Writing for Learning In Secondary School Science

V. Prain

There is now widespread recognition of the need to change the role of language in teaching and learning in secondary science. The researchers have participated in a four-year qualitative study (1993-1996) with eight secondary science teachers to investigate the effects on teachers and students of diversifying the types, purposes and readerships of student writing for learning in this subject. This paper reports on the development of a model, on the basis of this research, to support teachers and students to implement effectively writing-for-learning strategies in science classrooms.

Haney, Jodi

Session 9.07

Saturday, March 22, 1997
2:45pm-3:45pm
Oak Brook IV

Teachers' Beliefs Concerning Constructivist Teaching Practices in the Science Classroom

Julia McArthur

To gain a better understanding of emerging constructivist beliefs and classroom practices, longitudinal case studies were constructed for seven teachers during both their preservice and inservice experiences. The case studies provided insight into four primary questions: 1) what are the beliefs of teachers regarding constructivist teaching practices; 2) how did these beliefs develop over a science methods course and a student teaching experience; 3) do these beliefs change during the first two years of the profession; and 4) are these beliefs consistent with the teacher's subsequent classroom practices? Taylor, Fraser, and White's (1994) components of constructivist teaching were used as a theoretical framework in conjunction with Ajzen & Fishbein's (1980) Theory of Planned Behavior. Data (document analysis, classroom observation, and interviews) were analyzed using the constant comparative method. Findings from the case studies suggest that two kinds of beliefs were in operation: central and peripheral beliefs. Moreover, It appears that the teachers' beliefs during inservice are consistent with their prior preservice beliefs. However, the teachers perceived fewer support structures and more implementation obstacles during their first year of teaching.

Hansen, K.H.

Session 6.04

Saturday, March 22, 1997
10:30am-12:00pm
Cermak

The Meaning of Science Education for Grades 4-6 Students: Interest Structures Assessment by Multidimensional Scaling

In this study the interest structures of 2018 students of grades 4 to 6 with respect to the subject, science topics and learning methods were assessed within the framework of an innovative science education project. The scale items were analyzed by non-metric multidimensional scaling (MDS) for "individual differences," individuals being defined as student groups with integrated science and three comparison groups from a traditional curricular setting. MDS represents inter-item relationships as spatial structures. The MDS solutions indicate that interest in learning methods is structured by a perception as "hands-on" versus "paper and pencil" activities. Students structure their interest in science topics (thematical interest) in terms of the current versus future meaning of these topics and in the subject by enjoyment and successful mastering versus meaning for a future career. Furthermore, individual difference scaling helped to elaborate differences between student groups in terms of the subject taught and gender groups by a differential weighting of the MDS dimensions.

Harms, Ute

Session 3.07

Friday, March 21, 1997
7:00pm-8:30pm
Oak Brook II

Teaching Genetechnology Starting from Students' Conceptions - an Introduction

Corinna Gebhardt **Angela Kroß**

Pre-instructional conceptions on genetechnology and related topics (i.e. bacteria, microorganisms) were investigated by qualitative methods. The research focussed on the questions, which pre-instructional conceptions students' possessed regarding genetechnology and under which conditions they could be influenced. The present paper outlines the theoretical background and premises of the project presented in this session, i.e. the topics 'situated learning', 'interdisciplinary education' and 'moral judgement' in connection with 'genetechnology'. Based on the research results obtained, teaching materials for secondary school students were developed, taught in several biology classes and then evaluated. Proceeding from the students' conceptions on genetechnology, material was developed based on the concept of 'situated learning'. To deal appropriately with the many facets of genetechnology besides the biological aspects, the material takes ethical and social problems related to the topic into consideration. After application in biology classes, the material was evaluated especially under two aspects. First of all it was investigated whether and in what manner the students' conceptions on genetechnology had changed. In addition, it was tested if the students' ability for moral judgement had developed as a result of this kind of instruction.

Harrison, Christine **Session 16.05** **Monday, March 24, 1997**
8:30am-10:00am
Regency B

Charting Teacher Development on The CASE Project

This paper describes some of the events that teachers experience and pass through during a 2 year teacher development programme. It describes the professional development of a 'typical' CASE teacher, as well as some of the social and personal development achieved. From anecdotal reports by teachers at training meetings, trainer reports of teacher action in the classroom and interviews with teachers at different stages in the 2 year programme, it is possible to build a picture of teacher development throughout the programme and to relate the stages and, rate of acquisition of specific stages, to the types of support and/or constraints encountered. It will also hopefully enable teachers and trainers, participating in the programme, to consider how feedback, support and reflection aid teachers in modifying their beliefs and classroom practice by providing a framework against which individual progress and development can be compared and contrasted. As such, it offers a series of markers with associated targets that provide a focus and possible guidance for the emphasis of the next stage of training.

Haselhuhn, Charlotte **Session 8.09** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency C

Relationships of Student Gender, Personal Epistemological Beliefs, Science Self-efficacy, Attitude, and Subjective Norm to Intended High School Science Class Enrollment

Thomas Andre

Few students of either gender enroll in high school physics courses, but young women are especially underrepresented. A total of 698 freshmen from five Iowa high schools participated in a study in which Fishbein and Ajzen's Theory of Reasoned Action was applied to the study of the attitudes and social support that influence decisions to enroll in high school physics, chemistry, and biology classes. Attitude toward enrollment and social support for enrollment predicted enrollment intent in each area, with gender, academic ability, and self-efficacy explaining a small but significant portion of additional variance. Examination of beliefs underlying attitudes and subjective norm suggests that for physics enrollments to increase, students need to feel that they would be successful if they took a physics class, class activities must be enjoyable for male and female students, and parents and students must be aware of the advantages of taking high school physics.

Hazel, Elizabeth **Session 6.03** **Saturday, March 22, 1997**
10:30am-12:00pm
Spring Room

Views of Learning and Images of Scientists in University Science Texts: A Gender Perspective

Anthony Baker **Patricia Gallagher** **Robert Cheary**

Curriculum materials play a role in making a discipline relevant and attractive to students and encouraging their involvement. In science areas, important forms of gender bias in texts and other curriculum materials include lack of gender inclusive language, masculine images and exclusion of the feminine in course content and images; sexist assumptions; decontextualization and lack of reference to the social relevance of science and to domains of interest to women, lack of connection to the students' world; lack of reference to the community of scientists, to distinguished female scientists and to science careers for women; representation of women in passive, subordinate or decorative roles. The purpose of this study was to monitor gender and the texts used by first year students in the physical sciences at university level, focussing on the views of learning, the images of women and their presence as contemporary scientists or historical figures. It was found that women were marginally represented. The texts differed quite markedly in the extent to which images showed science as a human endeavour and in the views of learning embodied. The paper concludes with some discussion of ways of improving science texts actively to include women.

Hazel, Elizabeth **Session 6.03** **Saturday, March 22, 1997**
10:30am-12:00pm
Spring Room

Gender and Approaches to Qualitative research In Science Education: Exploring Phenomenography

Linda Conrad **Elaine Martin**

Phenomenographic research has been used in two main ways in science education: to look at what is learned (for example students' conceptions of acceleration) and to look at the experience of being a student or teacher of science. A critical feature of phenomenographic research is the generation of the "outcome space" in which the results of the study are summarised. The central idea underlying this exploration of gender and phenomenography is that women may be "lost in space" - the phenomenographic outcome space. First, women seem to be literally missing in the majority of phenomenographic studies, especially those based in the physical sciences where women are under-represented and in research samples in which women have not been present. Second, the traditional disciplines of study, the values of which largely determine the structure of the typically hierarchical outcome space, are distinctly patriarchal. Without attention to the hidden as well as the explicit aspects of what learners are coming to know, the understanding that we gain from the outcome space may be distorted. Third, the outcome space tends to be defined in cognitive terms, with such dimensions as the affective and aesthetic, often associated with women, being excluded or neglected.

Heatherly, Sue Ann **Session 17.14** **Monday, March 24, 1997**
10:30am-12:00pm
York 1,2,3

Inservice and Preservice Teacher Research Experiences: Impact on Views of Science

Aimee Barden **Eric J. Pyle** **Debra Hemle** **Patricia Obenauf**

The purpose of this paper was to detail the impact of a residential scientific research institute on inservice and preservice science teachers. A total of 276 participants took part in 1- or 2-week institute, conducting research using a radio telescope. As a result of their experience, participants were expected to design and implement a research-oriented instructional unit in their science teaching. The impact of the experience on the teachers' personal concepts of the nature of science and science teaching as well as on their students' appreciation of science was initially assessed by teacher journals and open-ended questionnaires. Data were analyzed using a descriptive approach to analytic induction. These results encouraged the development and use of a series of Likert-scale instruments to augment the journal data and obtain direct student data. Data were analyzed using paired-sample t-tests and 2-way ANOVAs where appropriate. Results show that the institutes had a profound impact on teachers and their students, with past participants altering their instructional approaches to incorporate long-term open-ended investigations, matching science teaching to "real" science".

Helms, Jenifer V. **Session 7.04** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook III

The Sociology of Science as a Means to a More Inclusive, Liberatory, and Authentic Science Education

Christine M. Cunningham

In this paper, we argue that insights from scholarship in the sociology of science can provide a powerful basis for making science education more authentic, more inclusive, and more liberatory. We argue that infusing sociological concepts into curricula can enhance science study by (1) preparing all students for the problems and decision they will face in our increasingly science-dependent society, (2) engendering more interesting and accurate views of science, (3) attracting, interesting, and retaining more students in science, especially women and minorities, and (4) encouraging students to explore new methods and problem spaces (which could, in turn, change the current face of science). We focus on three specific insights -- social networking, peer review, and skepticism -- to demonstrate how sociological understandings can inform the content, structure, and pedagogy of science classrooms. For each, we begin with a brief explanation of it role in science, then describe a variety of activities or pedagogical practices that can convey these understandings to students in a science classroom. In the closing section of the paper, we address some of the challenges that accompany teaching in a more sociologically informed style.

Helms, Jenifer V.

Session 9.05

Saturday, March 22, 1997
2:45pm-3:45pm
Oak Brook III

The "Commonplaces" of Science as an Analytical Tool for Science Teachers, Teacher Educators, and Researchers

In this paper I offer an analytical framework for thinking about science and school science. I propose that we follow J. J. Schwab's conception of the practice of teaching -- as a set of "commonplaces" -- for thinking about the practice of science and science education. Science can be described using this heuristic: "Science is an activity in which people employ **lenses** and **methods** to investigate **questions** concerning **natural objects and phenomena** in a particular **context** in the service of some **goal or set of goals**." The purpose of this paper is to illustrate how this framework can be used to foreground some of the interesting (and often neglected) aspects of science for teachers and educational researchers. I argue that considering science as a set of five commonplaces offers a potentially powerful framework for thinking about science education; establishing the meanings of each commonplace can provide a useful basis for analysis of classroom practice, and can help teachers design instruction such that all aspects of the nature of science are included. Further, the commonplaces can be established in such a way that renders them vulnerable to critique. In this way, lessons about science are highlighted.

Henriques, Laura

Session 4.01

Friday, March 21, 1997
8:30pm-10:00pm
Spring Room

Factors Influencing Teachers' Likelihood of Innovation Implementation: A Path Analysis

This study examines factors which impact teachers' implementation of an inservice innovation. Path analysis is used to construct a hypothesized model relating teacher created artifacts to subsequent teaching performance. Factors relating to the planning and organization of instruction serve as the independent source variables. Teacher and student performance and teacher revised curricula are the dependent variables downstream from the source variables. The context of the study is a multi-year NSF teacher enhancement grant for elementary school science. The project emphasizes the use of children's ideas, literature as a springboard for instruction, constructivism, and parental partners in a science teaching. The teachers in the study are from collaborating school district. The study sheds light on features of the inservice and participants which foster change.

Hester, Peter

Session 10.11

Saturday, March 22, 1997
4:00pm-5:30pm
Regency D

Fostering Teachers' Listserve Discourse and its Impact on Student Learning

Listserve discourse may enhance teachers' understandings of reform-based curricula and their ability to transform their classroom practices--thereby fostering more meaningful learning in their students. In this research I examined the discourse among teachers using a listserve designed to support an Internet-based curriculum. A preliminary analysis of the data indicates that the thirty participating teachers used the list in different ways. Some teachers focused mainly on project logistics, others on exchanging sets of meteorological data generated by their students, and a few began to examine important pedagogical issues. For many, however, the listserve served an important role as an on-going, interactive support structure for examine important pedagogical issues, such as teacher's personal modification and use of different pieces of the KGS program, including: activities that engaged their students and appropriately guided their use of multiple representations of data (imagery, narrative discussions, text); activities that helped kids make meaning of complex real-time information; activities that exemplified the reform-minded pedagogy of the KGS program; and a professional, virtual community which impacted their classroom practices by providing a vital, interactive forum for professional development and reflection.

Hilosky, Alexandra **Session 12.05** **Sunday, March 23, 1997**
10:30am-12:00pm
Kent 1,2,3

Profile of Instructional Practices in Beginning College Level Chemistry Lab Experiences

This study supports laboratory instruction as a means of developing higher-order thinking, yet too often courses are not structured, nor is laboratory instruction designed, to develop these skills. "Cook-book" laboratory experiences can be used effectively in inquiry-oriented instruction if the results following directions serve as the basis for explanations and post-laboratory discussion Laboratory based instruction will improve if final course grades are awarded on the basis of learning outcomes resulting from laboratory experiences and related post-laboratory activities. As taught at present, students develop habits that deter them from enrolling in advanced courses and taking responsibility for their own learning. It also fosters careless reporting of findings and drawing conclusions. While administrators at the 9-14 level verbally support the importance of laboratory-based instruction, they are not proactive in fostering a climate and/or necessary structures and support to assure more effective laboratory and post-laboratory experiences. Both high school and college level professionals responsible for laboratory instruction do not clearly define their objectives for inclusion of laboratory experiences in their courses. Consequently, these experiences cannot result in the learning; often new content is confused with changes in approaches to instruction.

Hobden, Paul **Session 9.14** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency D

But I Explained It So Carefully: An Analysis of Teacher Explanations in Physical Science

Teachers often spend time explaining the solution to questions and numerical problems in the hope that students will then be able to solve similar ones in examinations and tests. They seem to have beliefs based on an intuitive feeling, that if you tell it slowly, clearly and repeat it enough times, students will understand. Despite the personal experience that many teachers have that this is not very effective, teachers continue to use this strategy. This case study of two science teachers describes the context within which explanations are used in their teaching. Assertions will be made that there are particular features of classroom explanations which form barriers to understanding. A number of research based strategies will be suggested to increase opportunities for meaning making during and after teacher explanations.

Hofstein, Avi **Session 10.03** **Saturday, March 22, 1997**
4:00pm-5:30pm
Kent 1,2,3

Science Teachers as Curriculum Developers of Science and Technology for All

Rachel Mamlok **Miriam Carmeli**

The development of learning materials by teachers is recognized nowadays as an important and effective method of professional development of teachers. It is suggested, that the involvement of a teacher in the process of developing material will increase his/her motivation to teach this material in his/her classroom. In addition it is suggested it will also reduce teacher's anxiety to introduce new developed materials. Since 1994 a course has been conducted in Israel, titled: "Science and Technology for All". Twenty science teachers with different scientific backgrounds (i.e., chemistry, biology, physics and agriculture) participate in this course. Five groups of teachers were involved in the process of development of modules, interdisciplinary in nature, aimed at students who are characterized as 'non science oriented'. The course had two phases: in 1994-95, teachers were involved in gathering and writing learning materials; in 1995-96, implementation and assessment phase in which a trial version of the modules was tried out in schools. The assessment of the course was aimed at finding out about the contribution of the course to teachers' professional development and the suitability of the learning materials to both students' interests and abilities.

Hogan, Kathleen **Session 9.14** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency D

Comparative Cognitive Models of Teacher/Student and Student/Student Knowledge-Building Discourse

This study analyzes the discourse among 8th grade students, and between these students and their teacher, in the context of explanation and theory building tasks. Data were collected in two classrooms over a 12 week period as students worked to build, apply, test, and refine mental models of the nature of matter. Transcripts of student dialogue in small groups, teacher interaction with small groups, and whole class discussions were coded, judged for cognitive complexity, then analyzed using cognitive mapping and sequential analysis techniques. Analyses revealed that the teacher was a catalyst for the students' construction of ideas, and that students did not tend to appropriate the teacher's norms and standards for scientific discourse into their own discussions. Based on the style of productive reasoning that emerged both from the student culture and from the teacher's scaffolding, an intervention designed to foster students' collaborative reasoning skills in ill-defined problem contexts such as scientific theory building is being designed and tested.

Holliday, William G. **Session 7.10** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency E

Disentangling Popular Arguments: Aiming to Motivate Science Teachers and Improving Their Science Learning Environments

Piyush Swami

Researchers are becoming increasingly concerned that many popular arguments attacking public education may lack rational and empirical foundations, discourage and confuse some practicing educators including science teachers, and have economic, political and social consequences that are detrimental to science learning environments. Such public commentary may not be motivating students toward higher-order learning and scientific literacy. This study analyzes four arguments, provides research-based responses, and links this information to Pintrich and DeGroot's cognitive-based motivational model. Each argument is described and characterized as a questionable foundation for teacher motivation and improving science learning environments in today's classroom, followed by an elaboration. Then, an achievement-motivational theory is used to discuss a model for changing science teachers' disposition concerning the domains covered by these arguments, with implications for improving science learning environments. In summary, the four "attack" arguments recommend that educators in today's public schools need to: (1) produce more scientists and engineers, (2) stop academic performance declines, (3) adapt inexpensive foreign schooling methods, and (4) focus on competitive strategies rather than factors of social and economic inequalities. Counter-arguments based in evidence follow each of these four arguments.

Howe, Ann **Session 17.07** **Monday, March 24, 1997**
10:30am-12:00pm
Regency A

Factors Associated with Successful Implementation of Environmental Science Units by Interdisciplinary Teams

The concept of interdisciplinary teacher teams has been central to the goals of Project Alliance. Eighteen teams have participated in the project (each for two years), eight teams in Group I (beginning in 1994) and ten teams in Group II (beginning in 1995). In the summer, each team developed a field-based environmental science unit to be taught during the succeeding school year. Quantitative and qualitative data on teaming were collected. Outcomes were classified as (a) unit was team taught and extended beyond team, (b) unit was team taught, (c) unit was taught by individual teachers, and (d) unit was not taught. Factors examined for possible association with team outcomes included whether (a) team was formed in order to participate in project or already existed in school, (b) team remained intact, (c) support was received from project staff, school administration, community, and local scientist partner, and (d) team members were satisfied with the project. It appears that the most critical factor in successful implementation of the unit is the integration of the team into the school structure. Implications of this and other salient factors will be explored.

Howes, Elaine Virginia **Session 12.02** **Sunday, March 23, 1997**
10:30am-12:00pm
Cermak

Making a Difference: Creating Feminist Activist Agendas in Science Education Research and Teaching

Angela Calabrese Barton **Lynne Cavazos** **Lori Kurth** **Paula Lane**
Gail Richmond **Kathy Roth**

In this interactive, novel format session, presenters will provide a unique opportunity for participants to join in a working discussion resulting in concrete feminist activist approaches to teaching and learning in science. The "Suffrage Salad" activity, used by our feminist predecessors, will be the foundation of the session after the presenters share one of their own brief examples of activism in their teaching or research. In the spirit of community building, all interested participants will be invited to join a listserve to further the discussions begun during the session, and will also be given a hard copy of the ideas generated.

Hsiung, Tung-Hsing **Session 17.04** **Monday, March 24, 1997**
10:30am-12:00pm
Hunt 1,2,3

Action, Reflection, What's Next?: Our Story

Chao-Ti Hsiung **Zen-Hsin Wang**

Based on the structure of action research, the university base educator and elementary school base teacher worked together to witness whether or not the action research can be done under the current school environments in Taiwan. The current paper presents the contents of a formal conversation between educator and researcher. The educator and teacher should have an equal role in research design, data collection, identifying problems and interpretation results. The elementary science teacher agreed that the action research can help him to reflect his teaching performance and to improve his professional knowledge. However, the results also show that the teacher did not think he has the equal authority and role as the educator in doing the research. Based on the teacher's comments, the educator made the reflection on his role in the action research and the definition of meaningful research in science classroom.

Huang, Tai-Chu Iris **Session 3.10** **Friday, March 21, 1997**
7:00pm-8:30pm
Ogden

The Development of a Questionnaire for Assessing Student Perceptions of Classroom Climate in Taiwan and Australia

Barry J. Fraser

This paper reports part of a cross-national study of science classroom environments in Taiwan and Australia. Specifically, it focuses on the development and validation of a questionnaire to assess student perceptions of the classroom climate dimensions of Student Cohesiveness, Teacher Support, Involvement, Autonomy, Investigation, Task Orientation, Cooperation, and Equity. The development process included the translation of the English version into Chinese, the independent back translation of the Chinese version into English again by people not involved in the original translation, and subsequent changes to the wording where necessary. Further refinements were made based on interviews with students about their comprehension and interpretation of items. Administration of the questionnaire to 3,000 students in 100 grade 7–9 science classes in Taiwan and Australia supported each scale's internal consistency reliability and a priori factor structure.

Hunter, William **Session 6.02** **Saturday, March 22, 1997**
10:30am-12:00pm
Butterfield

The Philosophies of Science Within One Chemistry Research Group

George Bodner

This research project ascertained ideas about nature and philosophy of science held within a single research group in a large Chemistry Dept. Particular attention was paid to how ideas enter the group and how they are propagated within the group. Participant observation, interviews and written field notes were used to collect data. Triangulation was accomplished through the use of participant observation and interviews and through external investigator examination of field notes and interview transcripts. Final results of this project show that ideas about science enter the group from all the members, but that many different views about their work, its purpose, and its method exist within the group. Some members are unaware of the issues raised by philosophers of science about the goals of science, how science is conducted, and what science may be expected to achieve. Other group members did demonstrate an awareness of ideas that have been discussed by recent philosophers of science. Still other members were difficult to categorize because their ideas were still in a developmental stage.

Iuli, Richard **Session 7.03** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook II

High-Tech Concept Mapping Is People Centered: A Hands-on Review of Available Computer Software

Robert H. Abrams

The Meaningful Learning Group (MLRG) provides programs and resources for science educators and science education researchers, particularly in the areas of metacognitive tools and computer information technologies to facilitate meaningful learning. In our paper we discuss a variety of computer technologies for concept mapping. Our presentation will focus on a feature by feature review of two representative computer software programs, LifeMap and MacFlow, which can be used to construct concept maps, but which have differences in price, features and interface design. Participants will have an opportunity to try both programs during an interactive computer-based concept mapping session. We will discuss ways in which the Meaningful Learning Research Group has been developing ways to support people who use computer-based concept mapping and those wishing to do so.

James, Robert **Session 3.06** **Friday, March 21, 1997**
7:00pm-8:30pm
Kent 1,2,3

A Constructivist Approach to Staff Development

Caroline Beller

Typically, staff development activities attempt to impose on teachers one or more innovations developed outside their classrooms. The purpose of this study was to design a constructivist approach to staff development for an integrated science, mathematics and technology for middle school. The Stages of Concern Questionnaire provided data about the teacher's affective response to the project. Concerns data guided the development in interventions to facilitate the project. First year results showed that teachers needed information and skill development in the various elements of the project. Second year data showed that informational and personal concerns had been somewhat resolved, and that more opportunity was needed to focus on the impact of the project on student outcomes and how teachers might collaborate across schools and sites. Most schools have been successful in developing local curricular applications consistent with the purpose of the project. Two examples of materials developed will are included.

Jarrett, Olga S. **Session 9.01** **Saturday, March 22, 1997**
2:45pm-3:45pm
Hunt 1,2,3

The Effect of the Student Teacher and Supervising Teacher on One Another's Teaching of Science

Pamela T. Stana

The purpose of this study was to examine: (a) the effect of the supervising teacher on the science interest of the student teacher, and the effect of the student teacher on science teaching ideas acquired by the supervising teacher. The research was conducted in a field based science methods class in an initial certification masters program for elementary teachers. The 82 student subjects were surveyed on their interest in science and their feelings about how their supervising teachers taught science. 41 supervising teachers responded to a survey conducted 6 months to a year later. Results of regression analyses indicated a weak influence of the teacher on the student interest in science and a strong influence of effective student teachers on science ideas/approaches acquired by the teachers.

Jelinek, David **Session 6.08** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook I

Changes in Student Views of Science Participating in a Summer Experiential Science Education Program

This is a case study of 20 Upward Bound high school students participating in a six-week experiential science program at the University of California Santa Barbara. The primary intent of the study is to determine what influence experiential learning has on *student views of science* as opposed to a more traditional approach to science education, and to ascertain whether there is educational significance in providing a setting in which the student is immersed in activities meeting the so-called experiential criteria. I show changes in student views of science as they progress through the experiential program by providing an analysis of *student views* instruments, questionnaires, informal interviews, class projects, notes from debriefing sessions, and researcher/instructor observations. Analysis of the data reveal that students begin to overcome naive concepts about causal and other relations as they actively engage in experiential techniques and reflective processes, students feel more inclined to construct ideas by themselves and to investigate scientific processes when they take an active part in the process, the more active the process the more positive student views of science become, and that students demonstrated an increased ability to see greater application of scientific principles to their everyday lives.

Jensen, Murray **Session 12.09** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook IV

Transformative Uses of Technology for Teaching Biology in Developmental Education Settings

Data from this study identified trends in the uses of technology in biology programs within developmental education institutions. A rapid increase in the use in technology was detected, with some institutions moving much faster than others. Four factors were found to be common to all technology-rich biology programs: financing, time designated specifically for the modification of curriculum and instruction, technical support, and teacher interest in technology. One important trend detected was the increased frequency of computer simulations replacing hands-on lab activities. To improve biology curriculum and instruction, this study recommends supporting two large-scale endeavors. First, science education researchers must begin examining how to use computers, and other forms of technology, effectively within the lecture classroom and the lab. And second, biology educators who teach in developmental institution must be provided increased access to forums (e.g., conferences, journals, etc.) in which they are provided opportunities to learn how to use technology successfully in their programs.

Jiménez-Aleixandre, M. Pilar **Session 17.12** **Monday, March 24, 1997**
10:30am-12:00pm
Regency F

Argument in High School Genetics

Anxela Bugallo-Rodriguez **Richard A. Duschl**

This paper reports a case study focusing on the development of students' capacity to develop and assess arguments in the context of instruction in High School Genetics. The goals of the study are a) the identification of conditions for argument (and in general scientific reasoning) to occur in Science classrooms, b) the analysis of argument patterns used by students and c) the exploration of the degree of specificity, or subject-matter dependence of these argument patterns as related to Genetics. Participants in this classroom study are High School (9th and 12th Grade) students in Galicia (Spain). The methodology involved observation, video and audiotaping of students while working in groups in designing and solving problems during 13 sessions. Toulmin's argument pattern was used as a tool for the analysis of students' conversation. Results include discussion of what could be viewed as a students' version of the pattern, (claims and warrants) which were used the most, and of criteria for assessing argument.

Johnson, Janet M. **Session 10.07** **Saturday, March 22, 1997**
4:00PM-5:30pm
Oak Brook IV

Partnerships and the Contributions of Informal Teaching Experiences to Teacher Education

Dawn Pickard **Colleen O'Keefe**

From the survey data collected, it appears that elementary teachers having experience teaching science in an informal museum setting while still students themselves exhibit characteristics of dynamic, powerful elementary science education professionals exceeding the national norms. When the quality and condition of their classrooms and teaching characteristics are compared with national teacher characteristics collected during the last NAEP study, 31% of the sample indicate teaching more than 120 minutes of science a week as compared to 29% nationally. Nationally, 77% teach science an hour or more per week; of the Cranbrook constituents, 86% teach science more than one hour per week. In addition, the teachers having experience at Cranbrook appear to be innovative in classroom practices, with less than 1% relying on textbooks to teach science. The national norm is "science as reading" the textbook. Perhaps the most significant characteristic difference between teachers having experience teaching in an informal setting is the emphasis on manipulative, cooperative grouping and enthusiasm for doing science in elementary school.

Johnson, Judith **Session 10.05** **Saturday, March 22, 1997**
4:00PM-5:30pm
Oak Brook II

Building the Capacity for Sustainable School Change Through Teacher Research

The goal of the symposium session is to provide an interactive format for discussion where classroom teacher researchers can share their research findings as well as their personal reflections about the factors that sustain ongoing and sustained improvement in science and mathematics education. We will explore the potential of teacher research combined with innovative programs to build the internal capacity of schools to change and to meet the demands for 21st Century education. The Lockheed Martin/UCF Academy for Mathematics and Science education is a model for education/industry/community partnership aimed at science and mathematics educational reform. The key to the success of this Academy is the development of a cadre of teachers who provide leadership in educational research and the development, implementation, and assessment of effective and innovative teaching methods and materials. The systemic impact is evident as they are employed by their districts to present teacher inservices, make presentations at state and national conferences, and as they continue to mentor other teachers as well as preservice interns.

Johnson, Judith **Session 9.13** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency E

"It's Amazing What You Can Hear Yourself Saying": Learning to Teach Science Through Dialogue and Reflection

Preparing secondary science teachers for classrooms where the demographics are shifting and the terrain of scientific and technological knowledge that defines the curriculum in science is ever expanding, presents complex dilemmas. It is a challenge to prepare educators to deal with the increasing cultural, economic, language, and social diversity among students in order to provide an equitable science education for the skills, attitudes, and knowledge that will allow students to become productive citizens in the 21st Century. Science teacher preparation programs must confront theses dilemmas through a process of ongoing dialogue and reflection so that science teachers have the tools to change themselves, to make informed decisions about their actions in classrooms, and to be able to systematically address change. The purpose of this paper is to describe the ongoing study of secondary science methods classes to describe how the course is designed and redesigned to promote dialogue and develop reflective thinking in preservice students.

Jones, Leslie S. **Session 8.06** **Saturday, March 22, 1997**
1:00pm-2:30pm
Oak Brook III

Science Education for All??? Can We Achieve Educational Equity Without an Anti-Racist Critique?

Glen S. Aikenhead **Mary M. Atwater** **Ohkee Lee** **Sharon Lynch**
Alberto Rodriguez

While Science Literacy has become a common theme in proposals for science education reform, moving this concept from a goal to reality remains a daunting task for science educators. Many students continue to leave school without anything close to a reasonable level of scientific competence and certain groups of students are particularly marginalized by existing science curriculum and pedagogy. Our community has begun to embrace the idea of multicultural science instruction, but has basically overlooked the need for a sound antiracist critique of science education. Some multicultural approaches only address the increasing racial/ethnic diversity of students, but do not explore the significance of the invisible manner in which sociopolitical issues impact our science classrooms. A sound theoretical analysis could serve as a framework for development of effective strategies for more inclusive approaches to science education. In the hope of highlighting crucial concerns, initiating productive discourse, and engaging in the self-reflective examination needed to better inform our educational policies and practices, we plan to focus on educational equity through an antiracist critique of science education. A diverse panel of science educators will present position papers on related topics and open the session as a conversation among participants.

Jones, M. Gail **Session 14.08** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency C

Science Teachers' Conceptual Growth Within Vygotsky's Zone of Proximal Development

Melissa Rua **Glenda Carter**

In this study we examine teachers' development of understandings of science concepts and pedagogical content knowledge as a function of being a member of a dyad in a graduate teacher education course. Through extensive analysis of peer interactions and conceptual organization we probe how teachers' knowledge is organized and mediated, how science concepts are developed and how peers influence teachers' cognitive growth. This analysis is interpreted through two fundamental tenets of Vygotskian theory, the zone of proximal development and signs and tools as mediators of higher learning. The data provided evidence that there were multiple mediators of learning, one of the most powerful being the teachers' own students. Peer-peer interactions, which varied from topic to topic, took the roles of both cognitive apprenticeship and participatory appropriation. Understanding the flexibility of Vygotsky's zone of proximal development, the myriad of "more capable peer" roles that exist, as well as the interactions with mediating agents, provides a model of professional development capable of stimulating tremendous cognitive growth.

Jones, R. Lynn

Session 13.04

Sunday, March 23, 1997
2:30pm-3:30pm
Hunt 1,2,3

Equity, Bias, and Attitudes among Middle School Science Students

This study investigated middle school science students' perceptions of gender bias and their attitude towards science as a result of Gender Equity Strategies Training (GEST) received by a randomly assigned group of teachers. The study consisted of a control group (No GEST) and an experimental group (GEST). The Science Student Gender Bias Survey (SSGBS) and the Wareing Attitude Towards Science Protocol (WASP) was administered as a pretest to a sample of 182 students in West Central Alabama and as a posttest ten weeks later, following the GEST. Questionnaires were also administered to selected students following the posttest. Each shared perceptions and observations of science classroom behavior. Results indicated that there was a significant interaction for treatment and pre- and posttest scores for attitude towards science within the experimental group, indicating that those students had a more positive attitude toward science. The study suggests the need for more gender equitable classroom teaching strategies to actively encourage the participation of girls in science, thereby creating a more positive attitude toward science. Research supports the idea that students' attitude toward science and science achievement are positively related and that gender equitable teaching is good teaching for all students.

Ju, Huey-Fang

Session 10.04

Saturday, March 22, 1997
4:00pm-5:30pm
Oak Brook I

An Examination of Teacher Journals to Discern Teacher Reflective Thinking

One challenge in science education reform is to transform science learning into meaningful experiences for all students. Although the Science-Technology-Society/Constructivist (STS/C) approach helps students connect science and technology to their daily lives, it requires major paradigm changes for conventional science teachers. Therefore, it is important to understand the change process of teachers as they experience STS/C inservice practices. In this study, an analysis of teacher journals provides information concerning teacher conceptual development and their reflective thinking. These journals were kept by 161 K-12 science teachers who attended a yearlong STS/C inservice sequence. Qualitative research procedures were employed to determine emerging categories about how teachers reconcile the STS/C strategies with their existing schemata. Three characteristics were found: (1)Teachers combine new information with prior knowledge to construct their personal meaning; (2)When the inservice program provides ongoing support, teachers are more likely to accept STS/C ideas; (3)Collaborative teamwork helps teachers become comfortable with STS/C teaching. The acceptance of an innovative teaching strategy does not occur quickly. However, when teachers begin to sense the impact of STS/C in their classrooms, they become willing to make changes needed for the STS/C approach.

Jusoh, Ismail

Session 13.04

Sunday, March 23, 1997
2:30pm-3:30pm
Hunt 1,2,3

Relationship Among Integrated Science Process Skills, Logical Thinking Abilities, and Academic Achievement

Zurida Ismail

The purpose of this study was to identify the science process skills and logical thinking ability and the relationship among process skills, logical thinking and science achievement. About 268 senior high school students were involved in the study. Two criterion measures were used. Science process skills were measured using the Test of Integrated Process Skills (TIPS) and logical thinking was measured using the Group Assessment of Logical Thinking (GALT). Science examination results were used as measures of science achievement. The findings from the study showed that the students have achieved formal reasoning and that there is a significant relationship between logical reasoning, science process skills and science achievement.

Kamen, Michael **Session 7.09** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency F

Moments of Meaning: The Context and Discourse of Understanding in an Elementary Science Class

This study seeks to identify and describe elements which support children's understanding of science concepts. The classroom context including the role of the teacher, activities, discourse, teacher's stance and theoretical perspective, and discussions between children is examined to help understand children's movement to a more sophisticated understandings of concepts. The subjects are a classroom teacher and her students at an elementary school. This is a qualitative study that uses a number of sources for data. The primary data come from interviews by the researcher with the classroom teacher, direct classroom observations and videotapes, and interviews with students. Additional data are collected from the teacher's journal and interviews with school administrators. The study builds a series of mini-cases describing events surrounding acute understanding. From these mini-cases, patterns and assertions are discussed.

Katz, Phyllis **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Parents as Informal Science Teachers: Twelve Case Studies Broaden Continuing Research

This study expanded upon preliminary work done the previous year by refining the procedures and including parent "Adult Leaders" in the HOSO (Hands On Science Outreach) after school informal science education program from four demographically diverse locations. Theoretical foundations in parental investment and constructivism guided this work. The study took place over two program sessions and spanned approximately five months. Data were gathered to analyze motivation, content comfort, group management concerns, self image perceptions, and science related family interactions attributed to program participation. The qualitative methodology included semi-structured interviews, observations, questionnaires, drawings and journals. The study found commonalities in motivation and a range of self image perceptions and family/science interactions somewhat dependent on the self perceived entry point for participation.

Kelly, Gregory **Session 12.01** **Sunday, March 23, 1997**
10:30am-12:00pm
Butterfield

Using Ethnographic Analysis to Study School Science in the Making

Catherine Chen **Teresa Crawford**

In this paper we take a naturalistic perspective to study of the nature of science. Drawing from a three year ethnography in a high school physics class, we explore theoretical issues of research methodology in the context of studying science-in-the-making. We take the perspective that what counts as science is defined by members of the community through their actions and interactions with and through oral and written language. Central to this perspective is an understanding of the social and discursive practices of the epistemic communities comprising the scientific disciplines. The research approach is methodologically consistent with studies in the sociology of scientific knowledge (SSK) and suggests that classroom-based research should focus on the contextual factors and situated nature of meanings being constructed as group members affiliate over time. We explore methodological issues for the study of school science including the perspective taken by researchers of participants' views of science; the need for extended, over-time data collection and analysis; the naturalistic approach to the study of school science; and the importance of incorporating discourse analysis into studies of classroom interactions.

Kelly, Mary Kay

Session 6.08

Saturday, March 22, 1997
10:30am-12:00pm
Oak Brook I

Classroom Factors Associated With Systemic Reform in Science and Mathematics Education

Joanne Tims Goodell **Arta Damnjanovic** **Jane Butler Kahle**

The objective of this study was to investigate classroom factors in schools that had participated in Ohio's Statewide Systemic Initiative (SSI). A causal comparative research design and standard quantitative research methods were used. Students in SSI and non-SSI groups in the same school formed the comparison groups. SSI and non-SSI teachers were matched on several common characteristics. There were 511 mathematics students and 610 science students who completed the questionnaires and achievement tests. Three-way ANOVA indicated sex and race differences in science achievement and sex, race and group differences in mathematics achievement. For both mathematics and science, four factors emerged from the Factor Analysis of the student questionnaires and two factors emerged from the attitudinal items on the achievement tests. Three-way ANOVAs performed on each of the factors indicated there were sex and group effects but no race effects in science. There were interaction effects for group and race, and sex and race. In mathematics there were no group or interaction effects, however, both sex and race effects were identified. Comparing the science and mathematics results clearly demonstrates that the reform has had a greater impact on science classrooms than on mathematics classrooms.

Kesidou, Sofia

Session 14.06

Sunday, March 23, 1997
4:00pm-5:00pm
Regency A

Identifying Curriculum Materials for Science Literacy: A Project 2061 Analysis Tool

Jo Ellen Roseman

This paper describes the development of a procedure to evaluate how well curriculum materials serve specific learning goals such as the *National Science Education Content Standards* and *Benchmarks for Science Literacy*. Sixty K-12 teachers, curriculum developers, teacher educators, cognitive researchers, and scientists participated in the development and refinement of a prototype procedure in two cycles of materials evaluation. In both cycles, the reliability of the procedure was tested by having two teams independently analyze each curriculum material and noting differences in their findings. The procedure was tested in six sites to determine its utility and reliability in the field. The paper will present a description of the analysis procedure; efforts to refine and establish reliability of the procedure; and the kinds of results that can be obtained with the use of the procedure using as case studies primarily middle school materials that were developed with support of the National Science Foundation.

Keys, Carolyn W.

Session 10.10

Saturday, March 22, 1997
4:00pm-5:30pm
Regency C

A Novice/Expert Study of Science Writing: Moving from Data to Meaningful Inference

Writing in science has great potential to facilitate connections between prior knowledge and new information gained from inquiry, but few studies have examined students' writing in the context of authentic inquiry. The purpose of this study was to determine the frequency, placement, and coordination of meaningful inferences in middle school students' science reports. Science experts' writing was used as a benchmark. Students and experts wrote the reports in response to open-ended writing prompts in the context of zoo animal behavior and water quality projects. No explicit writing instruction was given. Results indicated that the majority (70%) of students included only 1 or 2 meaningful inferences about their data, but that some students (30%) included meaningful inferences almost or as frequently as the expert. These students also achieved a high level of synthesis between observations and inferences and demonstrated high levels of elaboration of main ideas. The results imply that many students would benefit from explicit instruction in moving from data to inferences and that middle school students have the potential to produce excellent science writing in the context of inquiry.

Khoo, Hock Seng **Session 12.07** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook II

Using Classroom Environment Dimensions in the Evaluation of Adult Computer Classes in Singapore

Barry J. Fraser

Reviews of past research on learning environments show that relatively few studies have involved (1) the use of environment dimensions as criterion variables in educational program evaluation, (2) samples of students in Singapore, and (3) adult learners (in contrast to elementary and secondary school students). This study is distinctive in that it used a learning environment instrument in program evaluation among 250 adults in Singapore. Factor analysis supported a five-factor structure (Teacher Support, Involvement, Autonomy, Task Orientation, and Equity) for the learning environment questionnaire, and scale alpha reliabilities ranged from 0.76 to 0.88. Generally, students perceived their learning environments favorably in terms of the levels of Teacher Support, Task Orientation, and Equity, and this pattern did not differ between different computing schools, between males and females, and between younger and older students (with the main exception being that females perceived lower levels of Equity). However, Satisfaction varied between the different computing schools, between the sexes, and between students of different ages. Students reported greater Satisfaction in classes perceived to have more Teacher Support, Involvement, and Task Orientation.

Kim, Hyewon **Session 13.07** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook III

How Plate Tectonic Computer Animation Affects Geology Students' Learning and Attitudes Towards Computer-Assisted Instruction

Three major problems in teaching introductory geology are: 1) the inability of many students to think three dimensionally about the earth and its changes, 2) the lack of interest of non-science students, and 3) the large lecture-hall settings and large number of students. These problems can be mitigated to some extent by using computer animation. Specifically, computer animation can prove particularly beneficial in simulating more abstract situations, such as the theory of plate tectonics, which can be difficult to demonstrate in a normal laboratory environment. We know that students have difficulty understanding concepts about plate tectonics, and this can cause many student misconceptions. Thus, the purpose of this study was to examine the instructional effects of different computer models (i. e., text only, text with static models, and text with animated models) of plate tectonics on subjects' learning of geology concepts and attitudes towards CAI. The results indicate that students using animated visuals did significantly better than students using static visuals which in turn did significantly better than a control (text only) group with respect to knowledge of plate tectonics and attitudes toward CAI.

Klapper, Michael H. **Session 12.09** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook IV

Exploring a Future for Education: Eisenhower National Clearinghouse as a Prototype of Electronic Resource

This presentation begins with the premise that current education reform is attempting to adjust a school structure that is inherently inconsistent with contemporary educational goals. Therefore, we should be looking to reforms that lead to alternate education design, in particular a future system based largely on digital electronic technology. Describing the Eisenhower National Clearinghouse (ENC) as a prototype for that future, the results of an analysis on the impact that the ENC has had on its teacher audience will serve to initiate a critique of current reform efforts.

Koba, Susan B. **Session 14.10** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency E

Empowering Teachers: A Critical Ethnography of a Multicultural Science Reform

The purpose of this collaborative, critical ethnographic study was to understand teacher culture during science reform; to determine barriers to reform; and to serve as an advocate during attempts to reduce barriers. The issue leading to this study was inequitable achievement of students of color in science. The research team developed a program which addressed this inequity; research occurred during implementation. Data included observations, interviews, journals, videotapes, and collaborative conversations. Thematic analyses were completed at three points during research and provided cultural snapshots which demonstrated teacher change. Barriers to change included personal barriers which arose from the paradoxes of teaching and from teachers' beliefs; professional barriers which dealt with teachers' power; and institutional barriers which limited teacher change. Conversational patterns and teacher perceptions of action research were used to determine the mechanics of change. Change was driven by praxis through cycles of reflection and action. As collaborative reflection increased, barriers were broken. Collaborative research/conversations which centered upon theory and practice promoted teacher change. A model of the change process was developed. Such information can provide direction in efforts to provide equitable science learning environments.

Konrad, Jane **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

Novice Constructivist Middle School Teachers

The purpose of this paper is to present data on six middle school teachers in the Pittsburgh area who are beginning an STS approach to science teaching project. Data are being collected using the ESTEEM Science Classroom Observation Rubric, Teaching Practices Inventory, Student Outcome Assessment Rubric, and Concept Mapping Rubric. The unique aspect about this project is that the teachers are new to constructivist and STS science teaching, but the students are not. This may be one of the first situations where the students push the teachers into reforming.

Koul, Ravinder **Session 9.08** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Development of Conceptions on Mechanics in Indian School Science Textbooks

This study examines the concept development and assessment on force, work, energy and their uses in current Grade IV - X Indian National Council of Educational Research and Training (NCERT) science textbooks. The study focuses on whether the strategies used in the textbooks provide the learner with open, problematic situations and inter-subjective learning to help students articulate science. The researcher devised concept-analysis and question and problem-analysis-schemes for the study. Results indicate that the NCERT textbooks employ a confirmatory, non-investigative approach to the development of conceptions on force, work, energy and their uses. A contextual, historical, investigative approach is proposed to improve the units on force, work, energy and their uses. The proposed pedagogical approach is especially pertinent for a resource-deficient educational system like India's, and offers a philosophically valid conceptual framework for textbook writers and curriculum developers.

Kozhevnikov, Maria **Session 9.06** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Parallelism in the Development of Historical Theories and Children's Ideas About Projectile Motion

Shulamith Graus Eckstein

A study of the development of children's conceptions about to projectile motion was carried out in Ukraine and Israel, with the participation of 1017 subjects in Grades 3 -12. The cross-country research made it possible to compare the effects of quite different school science curricula upon the development of children's concepts. The purpose of the research was to investigate the fundamental hypothesis of genetic epistemology, namely that the development of children's conceptions parallel the historical development of the concepts. Children's conceptions were categorized as being similar to concepts that were accepted at different historical periods. If the hypothesis of parallelism holds, then the development of children's concepts would proceed by stages, with each stage being similar to a corresponding historical stage. A mathematical model was constructed to describe development by stages. The theoretical model gave an excellent fit to the empirical data, and this supports the hypothesis of parallelism.

Krajcik, Joseph S. **Session 6.13** **Saturday, March 22, 1997**
10:30am-12:00pm
York 1,2,3

Using Technology to Support Students' Artifact Construction in Science

Michele Wisnudel-Spitulnik **Steve Stratford** **Elliot Soloway**

Science education reform calls for efforts to help students use and understand scientific phenomena, and to provide students with opportunities to demonstrate and develop their understanding. We are investigating ways in which computer learning environments can promote scientific literacy by encouraging students to engage in scientific inquiry and represent their understanding through dynamic models and hypermedia documents. Our thesis is that environments which facilitate the design and construction of technological artifacts containing externalized expressions of understanding are particularly valuable in helping students construct integrated understanding of scientific phenomena. In this presentation, we highlight the major premises developed in our paper. We will discuss two learning environments in which students created either dynamic computer-based models or hypermedia documents to express their understanding.

Krajcik, Joseph S. **Session 9.02** **Saturday, March 22, 1997**
2:45pm-3:45pm
Kent 1,2,3

Integrating Knowledge Bases: An Upper-Elementary Teacher Preparation Program

Mary L. Starr **Carla M. Zembal-Saul**

Integration of knowledge bases of teaching, i.e., content knowledge, pedagogical knowledge, pedagogical content knowledge is a priority in the development of expert teachers. This paper describes the implementation of one elementary teacher preparation program that focuses on elementary science teaching. The rationale around which the program was built, a description of the program including programmatic themes, and analysis of some of the program strengths and weaknesses particularly focusing on content representation are also included. As part of this paper, the research tools and methods used throughout the teacher preparation program will be discussed. The tools included semi-structured interviews, lesson plans, lesson reflections, and videotapes of the preservice teachers' first teaching opportunities. The methods through which these resources were used to develop deeper understanding of preservice teachers' potential will also be included.

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Kroß, Angela **Session 3.07** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook II

Connecting Research and Classroom Teaching Regarding the Subject of Genetechnology: Presentation of two examples

Ute Harms

This study outlines the educational consequences for the curriculum design and for teaching materials drawn from the research results of our project on students' conceptions concerning genetechnology. The design of the modules considers the following theoretical perspectives: (a) students' conceptions about genetechnology, (b) the affective preconditions and effects of instruction, (c) ethical principles pertaining to genetechnology, (d) the concept of 'situated learning'. The modules are developed for biology lessons in secondary schools. The main aims of the teaching material are to inform the students about the biological basis, the application possibilities as well as about the chances and risks of this new kind of biotechnology. The teaching process includes situations, questions and problems that a genetic engineer has to cope with in real life. We propose two teaching sequences in different application fields of genetechnology e.g. 'Genemodified Food' and 'The Human Genome Project'. Students' activities designed like complex situations in real life including experiments, discussions and decision making, will be presented. The testing of these teaching moduls in the school showed that the pre-instructional students' conceptions have taken a step towards the scientific concepts on genetechnology.

Kurth, Lori A. **Session 3.04** **Friday, March 21, 1997**
7:00pm-8:30pm
Cermak

Uchenna and Juwan: New Member Entry into an Elementary Science Discourse Community

Edward L. Smith

We examined the entry of two new students, Uchenna and Juwan, into elementary science discourse communities. Their classrooms had weekly half-hour science discussions using oral discourse components of agreeing, disagreeing and reasoning. Students had primary autonomy in carrying on the conversation. As the new students attempted to gain access to the conversations, norms were broken and/or highlighted. Our objectives were to describe the patterns of interactions in the science conversations, to identify the norms that developed and to analyze the role of discourse components in giving students access to the conversation. Through classroom videotapes, field notes, and student and teacher interviews, we found that the communities underwent a *transformation of participation* in adjusting to the entry of the new students. Both Uchenna and Juwan initially acted in ways stereotypical of their genders. Uchenna was quiet and reserved and often ignored by the other students. She, therefore, required a great deal of support from the teacher. Juwan was loud and outspoken and was assisted by both the students and teacher in recognizing the norms of the group.

Kyle, William C., Jr. **Session 14.05** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook III

Critical Educational Studies in Science Education

Critical educational studies as a worldview for inquiry offers the ontological, epistemological and methodological avenues to help establish a critical social consciousness capable or pertaining existing ideology, supporting independent judgment, and maintaining the freedom to envision alternatives. Critical educational studies offers a kind of praxis that connects schools and the larger society, such that the teaching-learning process becomes both a site and a form of cultural politics. My portion of the presentations will trace the ontological, epistemological and methodological history associated with cultural studies and critical educational studies. I will address the discursive shifts in political curriculum theory, from reproduction theory to resistance to the inclusion of popular culture and border pedagogy, and the implications for science education and science teacher education. In addition, I will address the shortcomings of the basic paradigm associated with scholarship in science education (that is, a focus upon a limited range of disciplinary work, primarily science disciplines and psychology, and the need to integrate critical cultural, political, and economic considerations into the fabric of science education scholarship).

Ladewski, Barbara G. **Session 16.03** **Monday, March 24, 1997**
8:30am-10:00am
Oak Brook I

Constructivism, Social Constructivism, and Soviet Activity Theory: Interpreting the Learning Experiences of Two Middle-Grade Science Teachers

How do teachers develop an understanding of and learn to orchestrate complex new instructional approaches, particularly if those approaches come into conflict with apparent constraints of the teaching context, or with teachers' prior knowledge or beliefs about teaching and learning? What theoretical models/frameworks are helpful in developing an understanding of the continuing learning processes of experienced teachers--professionals with well-developed, field-tested ideas about teaching and learning who must find time to develop new understandings as they continue to deal with the complexities of running their classrooms? The paper explores these questions through in-depth case studies, examining from multiple perspectives over an extended two-year period the learning experiences of two middle-grade science teachers as they attempted to understand and orchestrate multi-faceted inquiry-based learning environments in their classrooms. The paper explores these questions through three different theoretical lenses--constructivism, social constructivism, and Soviet activity theory--and compares and contrasts the different perspectives these frameworks offer for interpreting the case studies. Synthesizing ideas from these three frameworks, the paper explores development of a possible model of experienced teacher learning that attempts to represent the complex network of interrelationships among the various components and dimensions of a teacher's world.

Larson, Jane O. **Session 10.10** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency C

Constructing Understandings of the Mole Concept: Interactions of Chemistry Texts, Teachers, and Learners

The purpose of this 'case study of learning' was to chronicle the development of high school students' conceptions of the mole following a period of instruction in a chemistry class. As part of an ethnographic study of curriculum modulation, the investigation first documented class activities through participant observation. Next, the chemistry text's presentation of the mole concept was analyzed and compared to the teacher's instructional techniques. Finally, students' understandings of the mole concept were examined in relation to the text and teacher influences. Five areas of consideration were revealed by a general failure of students to construct meaningful understandings of the mole concept: (1) inconsistency between the instructional approaches of the textbook and teacher, (2) confusing mole concept vocabulary, (3) student math anxiety and proportional reasoning ability, (4) learners' cognitive levels, and (5) lack of practice in problem solving.

Lavoie, Derrick R. **Session 7.08** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency C

Using A Modified Concept Mapping To Identify Student's Alternative Scientific Understandings of Biology

The purpose of this study was to compare the effects of using a combined reflective writing/concept mapping strategy to identify students' alternative conceptions of biology with that of traditional concept mapping. An initial pretest established equivalency of a treatment and control group which were comprised of elementary education majors enrolled in a university-level biology content course. Students' alternative conceptions were identified for ecosystems, life cycles, metabolism, photosynthesis, and respiration. The addition of reflective writing increased students' attention to analyzing, identifying, and modifying conceptualizations of the subject matter. The treatment group exhibited significantly greater diversity and elaboration of alternative conceptions. The compiled list of alternative conceptions should be useful to secondary and post-secondary biology instructors.

Lawrence, Chris **Session 6.07** **Saturday, March 22, 1997**
10:30am-12:00pm
Kent 1,2,3

Assessing and Promoting Reasoning Through STS Experiences In High School

John Craven, III **Tracy Hogan**

In this study we explored the following questions regarding high school students' reasoning during a Science, Technology, Society (STS) extended learning experience in an Ecology course: 1) What is the nature of students' thinking regarding a given complex science-based issue and how do students' thinking and reasoning change during the course of an STS learning experience? and, 2) What influences help promote the development of students' reasoning and how? Furthermore, the study explored the practical use of this kind of assessment in the classroom and whether the scoring rationale can be used by the teacher to help move students to more sophisticated levels of thinking through the collection of qualitative data. Students in two sections of a high school ecology course wrote essays and the quality of and changes in their thinking were explored using the *Levels of Cognitive Complexity* scoring rationale. This instrument was chosen because of the match between the theoretical framework for thinking and the goals of constructivist/STS science experiences. Additionally, Both qualitative and quantitative analyses will be presented in our discussion.

Lawrenz, Frances **Session 14.02** **Sunday, March 23, 1997**
4:00pm-5:00pm
Kent 1,2,3

An Evaluation of the Effect of the SS&C Curriculum on Ninth Grade Students

Douglas Huffman

This paper explores evaluation issues in the TEAMS teacher preparation project. The formative evaluation addresses problems of management, communication, shared leadership, recruitment and retention of underrepresented groups and negative student responses to course and program changes. The summative evaluation addresses the outcomes of the project in terms of performance outcomes, the Hawthorne effect, self-selection of students and what it means to be a prepared teacher. The evaluation revealed that communication, management and recruitment are areas in which improvements can be made. Negative student response were few because of the intimate nature of the program and the amount of faculty attention and student/faculty interactions. Nevertheless, students at times feel uneasy about the ambiguous nature of the constructivist approach. Two issues raised in the summative evaluation will have to be thought through carefully so that a judgment can be made about program success. Both of these issues raise the question of generalizing success when the program becomes larger with a less select group of students in an institutionalized program.

Lawson, Anton E. **Session 8.12** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency F

Searching for a Fifth Stage of Intellectual Development in College Biology

Nicole Drake **Jennifer Johnson** **Yong-Ju Kwon** **Christopher Scarpone**

The purpose of this study was to test a novel five-stage theory of intellectual development in which the fourth and fifth stages are characterized primarily by a person's ability to test alternative causal propositions in a hypothetico-deductive manner. Stage four hypothetical reasoning successfully tests causal propositions when the alternative causes are observable. Stage five theoretical reasoning extends such reasoning to situations in which the possible causes are non-observable. The five-stage theory led to four specific experimental predictions that were tested with college biology students. Three of the four predictions were confirmed and the fourth prediction was partially confirmed. Therefore, initial support for the five stage theory was obtained. Classroom implications will be discussed.

Lazarowitz, Reuven **Session 13.03** **Sunday, March 23, 1997**
2:30pm-3:30pm
Harger

Learning Science in the Cooperative Mode in Junior and Senior High Schools

Yehudit Dori **Jehuda Huppert**

High schools' classrooms are highly heterogeneous. This heterogeneity is characterized by students' ethnic origin, gender, cognitive stages, learning styles, abilities, needs, motivation and interests. This heterogeneity raises the issue of the suitability of the science curricula offered, in terms of the learning material and the methods of learning and instruction. A second issue, not less important, is the lack of social interaction among the students during the frontal-expository learning process which occurs in most of the science classrooms. Yet it is well known that academic achievement relates to the methods of learning and teaching, students' social skills, and classroom learning environment. The cooperative learning approach was found to be one of the possible method of instruction which may cope with the problems of the science classrooms heterogeneity in a successfully way. In this symposium we will present the main trends in the cooperative learning approach which were used in high schools science classrooms, the results on the cognitive and affective domains and issues related to the implementation of this method in the classroom and the laboratory work.

Leander, Kevin **Session 16.03** **Monday, March 24, 1997**
8:30am-10:00am
Oak Brook I

How the Tensions of Communication Between Elementary Teachers Shape Curriculum Implementation

Osborne, Margery

As a team of teachers selected from one school district have developed an activity-based science curriculum and disseminated this change, they have challenged many local traditions of science learning and professional development, initiating personal and professional tensions between teachers and their colleagues. In this study we analyze the teacher-to-teacher development process as a negotiation of tensions between change and tradition, authority and peer relationships, and predetermined and evolving meanings. Through ethnographic data and interpretive analysis, we discuss how different teachers take up diverse voices in three phases of development of the curriculum: exploring ideas and materials, writing and piloting curricula, and training peers in informal and formal ways. Rather than depicting whole-school dissemination as a final "stage" in the change process, we analyze how response to peers as an audience shapes the entire development sequence for the curriculum team members. The voices that teachers draw upon as they talk to other teachers--those of the community, peers, science authorities, children, and the administration--provide the basis of our interpretation of the social craft of teacher-teacher dialogue. By offering a view of the change process as interpersonal and dialogic, our analysis permits us contribute to an understanding of how teacher leadership itself is developed and negotiated.

Leary, Rosemary F. **Session 13.02** **Sunday, March 23, 1997**
2:30pm-3:30pm
Cermak

Impact of Front End Evaluation on Exhibit Design in a Science Center

Laura Martin

Science centers use front end evaluation before exhibit design begins to gain information about visitors' knowledge of the topics considered and about their attitudes and motivations. The purpose of this study was to determine public interest in biology topics, to gather information on public conceptions of science topics related to the planned biology exhibits, and to explore public attitudes toward various biology topics. Semi-structured group interviews were conducted with 44 adults and 32 eighth grade students. Results indicate that both adults and children have partial and often fragmented knowledge of the biology topics explored. There was little understanding of applications or of functions. Individuals had heard the vocabulary, could use the vocabulary, but were unable to connect items together to form a coherent picture. They were also unable to extend their understandings to everyday, real world experiences. Level of education and gender accounted for variations in the scientific understandings held by the adults. Both adults and children were interested in the topics and both wanted to learn more about them.

Lee, Okhee **Session 12.11** **Sunday, March 23, 1997**
10:30am-12:00pm
Windsor

Science Conceptions among Linguistically Diverse Students

Sandra H. Fradd **Frank X. Sutman**

The study examined science conceptions by fourth grade students from Spanish, Haitian Creole, and English language backgrounds. The study has three purposes: (a) to describe students' conceptions of matter and changes of state; (b) to examine the impact of instruction on students' conceptions; and (c) to compare similarities and differences in conceptions among the three language groups before and after instruction. The study is based on two theoretical perspectives that were integrated into science intervention: (a) research on student conceptions from a cognitive science perspective, and (b) research on cultural congruence from a socio-cultural perspective. Before and after science instruction, a paper-and-pencil test and a clinical interviews were administered to examine students' conceptions and changes in their conceptions after instruction. While students expressed a wide range of conceptions different from scientific conceptions, the groups seemed to hold similar conceptions about matter. Despite significant improvements after instruction, less than desirable performance suggests that for effective science instruction to occur, teachers should be able to relate students' conceptions and cultural and linguistic experiences with scientific conceptions and the nature of science.

Lee, Soo-Young **Session 8.07** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency A

Assessing Students' Microscopic-level Understandings of Common Chemical Phenomena

Shirley Magnusson

Chemistry involves both macroscopic and microscopic level representations of phenomena. However, most assessments in chemistry do not require students to represent macroscopic-level phenomena in microscopic terms. Research examining students' knowledge of representations in chemistry indicates that students have difficulty connecting these levels of representations, but our current knowledge of the range and extent of their difficulties is limited. We interviewed college students' in an introductory chemistry class (n=450) about their microscopic-level representations of solution chemistry. Students in our stratified random sample (n=12) observed physical and chemical reactions and were asked to describe and graphically represent them at the microscopic level. Students' drawings were analyzed according to the understandings depicted by them, and four different models emerged from students' understandings of microscopic level representation. We described these models and what they revealed about students' understandings. These results were used to construct prototypic multiple choice assessment items that could be included on quizzes or exams to assess students' microscopic-level understandings. We recommend that microscopic level representations be included regularly in chemistry assessments to foster understanding of macroscopic and microscopic level representations of chemical phenomena.

Lee, Teresa I-Ping **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

An Interpretive Study on Instructional Representations of a High School Biology Teacher

Huang, Iris

This case study investigate the development process °B meaning and affecting factors of practical instructional representations of a high school exemplary biology teacher. With the interpretive research methodology, the result of this study reveals the case teacher's instructional representations involved a cycle through the activity of: comprehension, planning and preparation, teaching situation, and evaluation and reflection. Subjects teaching and learning direction and approach enriched the instructional representations. The case teacher's instructional representations were under the influence of personal disposition and style, his respected teacher, accumulating of experiences in learning and teaching, in addition to the beliefs on teaching,on students' learning, on classroom management, on scientific epistemology, and the practical knowledge of teaching materials, the object of teaching, evaluation, teaching context, and constraints. Finally, "Logical-Structural World View" explore the case teacher's instructional representations. The world view developed by the case instructor closely mimic and interact with his instructional representations and its impact on fellow students.

Lehman, James D. **Session 7.03** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook II

The Effects of Concept Mapping and Metacognitive cues in a Hypermedia-based Genetics Program

Pei-ling Lee **David Eichinger** **Franz Frederich**

Concept maps have been used widely in science education, however, few reports have examined the effectiveness of using concept maps in a hypermedia-based science learning environment. Metacognitive cues have been reported as a useful means to help learners monitor and internalize learning in a hypermedia-based environment; yet, research indicates that more research in this area is needed. This study used a 2X2 factorial design to probe the effects of using concept maps and metacognitive cues in a hypermedia-based genetics program. Can concept maps and metacognitive cues both enhance learners' learning when they are integrated in a hypermedia-based learning program? Will concept maps and metacognitive cues interact each other and affect learners' achievements? What are students' perspectives when they participate in the study? The preliminary analysis from both the quantitative and qualitative data revealed that all four groups of the subjects benefited from the hypermedia-based genetics program and students preferred using hypermedia-based learning material. The main effect of treatments was not significant. The interaction of treatments was significant at $p=0.05$ level. Students favored having embedded unit concept maps in the program, while metacognitive cues treatment received split comments.

Lehman, James D. **Session 3.06** **Friday, March 21, 1997**
7:00pm-8:30pm
Kent 1,2,3

Project INSITE: Training Teacher for Technology Integration in Project Based Science

Susan Mandell **Michael Rush** **Margaret Buchanan**

Calls for reform in science education stress the need for development of scientific literacy through inquiry-based, integrative approaches that provide students with the opportunity to solve authentic problems with the help of appropriate uses of technology. Project INSITE, a school-based project supported by the National Science Foundation, provides training to teachers in grades 5-9 for the development and implementation of project-based science and technology activities for the classroom. During the summer of 1996, approximately 70 in-service teachers took part in a three week summer institute. This institute involved the teachers in modeling project-based science activities that incorporated appropriate uses of technology, reflecting on teaching, developing new technology skills, interacting with scientists and science-oriented organizations, and developing project-based science curriculum. This paper reports on the evaluation of the summer teacher-training institute. The evaluation was designed according to the process and product categories of Stufflebeam's CIPP evaluation model. The results indicate that the approaches used in the institute were successful in promoting project-based approaches to science education and appropriate uses of technology among the in-service teachers.

Lennon, Diane **Session 17.10** **Monday, March 24, 1997**
10:30am-12:00pm
Regency D

Teachers as Reflective Practitioners

Karen Wolner

During a two year period 9 science teachers were observed as they confronted their own cultural realities and explored ways that their interpretations of culture influence their teaching and interactions with students. The teachers during year one received 45 hours of gender and cultural sensitization training, the purpose of which was to inculcate in teachers an in-depth knowledge and appreciation of the role of gender, culture and psychosocial factors in the teaching and learning paradigm. This training was followed by their teaching 60 students at a summer camp followed by their return to their classroom. The next summer they returned to the camp as teacher leaders, their reflections continued into the following academic year. The teachers were required to keep daily logs of their reflections. As reflective practitioners, who based on their participation in the teacher training program, their work with students during the summer camp and their subsequent reflection they slowly developed and taught science curricula, which are gender and culturally sensitive. In the paper they reflect on the process of sensitization in their personal and professional lives and the effect of this awareness on science teaching and learning in their classrooms.

Letts, William J., IV **Session 12.12** **Sunday, March 23, 1997**
10:30am-12:00pm
York 1,2,3

Student Learning of Science Embedded in its Cultural Context: Discovery of the Structure of DNA

This study examined student learning that occurred in the context of a science unit about the discovery of the structure of DNA. The unit was designed by a university researcher and three high school teachers to teach both the more 'traditional' content about DNA, and also to teach the students about the cultural and historical frameworks within which this work took place. In this way the unit addressed 'nature of science' issues embedded in other content. By adopting the role of one of the scientists involved in the discovery, students had the opportunity to examine the social epistemologies that played a part in the discovery. Student learning was assessed by examining written journals, interview transcripts, and final assessment responses. Using an ideographic analysis, student responses to probes were aggregated into similar perspectives and examined for the views of the 'nature of science' they exhibited. The data are suggestive that this approach to teaching science fosters engagement, interest, and knowledge acquisition.

Lewis, Bradford F. **Session 10.06** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook IV

Underrepresentation of African Americans in Science: Re-examining Current Explanations

In the United States, African Americans are underrepresented among employed Ph.D. holding scientists (comprising fewer than 2%). Researchers, focusing on the career choices of African Americans, have identified many factors associated with underrepresentation. The objective of this study is to deepen current understanding of underrepresentation, by providing explanations of how three factors (expectation of monetary gain, exposure to role models, and level of self-confidence in ability) influence the career choices of African American students. Utilizing a theoretical framework which maintains that human behavior is directed by world view, and that world view is shaped by environment, this study presents an analysis of the world view contents of three African American college students to identify the salient world view images and assumptions influencing their career choices. The research is interpretive, employing a case study design. Primary methods of data collection are interview and interview analysis. Findings reveal that each of the three factors had an influence on students' career decisions. However, the students' explanations of how the factors influenced career decisions often contradict explanations found in existing literature. The author recommends that future research focus on students' interactions with educational institutions to better explain how these factors lead to underrepresentation.

Lewis, JoAnne Ollerenshaw **Session 6.05** **Saturday, March 22, 1997**
10:30am-12:00pm
Harger

Success in GER Courses: A Study Based on Students' Behaviors and Attitudes, and Instructional Strategies

This case study takes an insider look at a General Education Requirement Natural Science Course. The researcher was a participant observer attending and completing all aspects of course learning, planning and instruction. Kolb's Learning Style Inventory (LSI) was administered and a formal interview identified specific pertinent demographic information about the six case study student volunteers. Results indicate clearly why these students did not succeed in the general education science course. Each of the six students had their own individual learning styles strengths: abstract, reflective, concrete, social or active. The students did participate fully in the traditional reading, watching and listening Science Course. When they encountered failure at midterm, they resigned themselves to the "just get me through mode". The students lost their initial positive attitude toward science from the beginning of the class. The result is scientific illiteracy and the student's inability to apply their knowledge of science to solve problems in everyday life.

Liang, Ling L. **Session 16.04** **Monday, March 24, 1997**
8:30am-10:00am
Regency A

Implementation of a New Constructivist Science Curriculum for Prospective Elementary Teachers

This study examined the effects of a new constructivist curriculum (Powerful Ideas in Physical Science, PIPS) for elementary education majors. It was hypothesized that the pre-service teachers who experienced the PIPS approach would demonstrate better learning outcomes in their understanding of science concepts as well as in their attitudes toward teaching and learning science, compared to their counterparts involved in a more traditional teaching approach (i.e., lectures, demonstrations, and verification laboratories). Using a nonequivalent control-group design, statistical techniques were used to analyze the scores on the test of student understanding of the target science concepts and on attitude surveys. Qualitative data analysis was also conducted based on the researcher's classroom observations and interviews of the selected preservice teachers. Results of the study revealed both promising aspects as well as problems of the PIPS curriculum. The research-based knowledge from implementing the PIPS curriculum has implications not only for the developers of the PIPS curriculum, but for all science curriculum developers and science educators who attempt to incorporate the most current learning theories or research results to promote science learning and teaching in general.

Liu, Chin-Tang **Session 14.02** **Sunday, March 23, 1997**
4:00pm-5:00pm
Kent 1,2,3

The Effectiveness of a Science Education Reform Program with Respect to Ninth-Grade Student Achievement

Scope, Sequence, and Coordination (Iowa-SS&C) Program on the Science Process Skills of 9th graders. The Iowa-SS&C program which is funded by the National Science Foundation and the University of Iowa, is one designed to engage grades 6-10 science teachers in restructuring their school science curriculum. Scientific inquiry skills are one of the major assessment components outlined in the National Science Education Standards developed by the National Research Council. An experimental design with the pre-test and post-test procedure was implemented in this study to examine the differences of attainment in process skills between the students who exposed to the Iowa-SS&C program and the students who did not. A process skills test modified from the 1992 National Assessment of Educational Progress was used. The results indicate that the program had a significant effect on the science process skills such as interpreting data, formulating hypothesis, defining operationally, and experimenting.

Liu, Xiufeng **Session 6.10** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook IV

Students' Conceptual Change in Structural Characters on Solutions

Xiufeng Liu

The purpose of this study is to apply digraphs (directed graphs) as a methodology to assess students' conceptual change in structural characteristics of the conceptual space. One Grade 7 general science class was involved in this study. Students were asked to write a paragraph or two to describe what they knew about solutions at the beginning, in the middle, and at the end of the instruction of the unit on solutions. Representative students were also interviewed and sample lessons were video-taped. Students' writings and interview transcripts were then transformed into digraphs which were in turn decomposed into digraph components. Qualitative characteristics of digraph components in terms of meanings and the quantitative characteristics based on the number of different types of digraph components, number of digraph components, and elements contained in digraph components indicated a conceptual change in students after the unit of instruction. The implications of the findings to science teaching and assessment were discussed.

Lomask, Michal **Session 7.12** **Saturday, March 22, 1997**
12:00pm-1:00pm
York 1,2,3

The Validity of Teacher Portfolio Assessment

Michael Seroussi **Helen Regan**

This paper describes and examines the psychometric qualities of a new portfolio-based teacher assessment system. The program is part of a new induction and certification system for beginning science teachers in Connecticut, which was developed and studied during the 1993-1996 school years. The program has two main goals: a) Creating an assessment system that can provide valid and reliable information about teachers' performances in relation to a standard-based, state-wide teacher certification process and b) Providing support for beginning teachers and professional growth opportunities for science mentors and portfolio assessors. The first goal, assessment, is achieved through a self-documented teaching portfolio and a detailed, dimension-based evaluation system. The second goal, support, is achieved through an induction program that includes school-based mentoring and regional, two-year-long, science teaching seminars. Both aspects of the program, including data gathered through studies done to support the validity and reliability of the assessment component, are described in this paper.

Louden, Cynthia K. **Session 6.07** **Saturday, March 22, 1997**
10:30am-12:00pm
Kent 1,2,3

Block Schedule and Achievement of North Carolina Students

The purpose of this study was to determine whether end-of-course achievement test scores for North Carolina students in block-scheduled schools and traditionally scheduled schools varied significantly. Physical science, physics, chemistry, biology, geometry and algebra I achievement test scores of all North Carolina public school students were considered in the analysis. A small number of scores were excluded because the school failed to report schedule type or used a block schedule type other than 4X4. Schools were categorized as traditional, implementing block schedule in the beginning of the 1994 school year or the beginning of the 1995 school year. Mean test scores from the end of the 1995 school year were compared for each of the three categories of schools, using test scores from the end of the 1993 school year as a covariate. The number of schools included in the analysis ranged from 204 for physics, to 224 for algebra I. The only significant difference between achievement scores in block scheduled schools and non-block scheduled schools was in physical science.

Loving, Cathleen **Session 17.03** **Monday, March 24, 1997**
10:30am-12:00pm
Oak Brook I

Formal and Informal Assessments of Views on the Nature of Science

Norman Lederman **Jill Aldridge** **Nancy Brickhouse** **Catherine Cummins**
William Cobern **William Letts**

Participants will offer a wide range of research ideas (12 different papers) for assessing views on the nature of science. Whether assessing PreK-16 student, teacher, scientist or the everyday person on the street, these research ideas will assist in expanding our knowledge of both formal and informal assessments. Example topics are 1) Development of the Beliefs About Science and School Science Questionnaire-BASSSQ (Aldrige & Taylor),2) Problems and Concerns with the Assessment of Knowlege and Teaching of the Nature of Science (Lederman), 3) Exploring Student Learning of the Nature of Science in a College Science Course (Brickhouse, Dagher, Letts, Ramseur,Shipman), 4) Preservice Elementary Teachers conceptions of the nature of science and how they change during science methods class and student teaching. A modified round table set-up in a very large room will accommodate folks to move from table to table, discussing papers of 2-3 folks at each table. Synopsis of each paper will be available on the NARST listserv March 1.

Lowrey, Kirsten **Session 12.12** **Sunday, March 23, 1997**
10:30am-12:00pm
York 1,2,3

An Alternative Mode of Instruction: A Detailed Analysis of Three Units in an Organic Chemistry Course

George M. Bodner **G. Marc Loudon**

Many educators have criticized college faculty for not expanding their instructional repertoire beyond "traditional modes of instruction" to incorporate "alternative modes of instruction." However, progress towards this goal has been slow. As a way of encouraging change, we need to provide the community with models that illustrate what successful alternative modes of instruction look like, how they are implemented, and why someone would want to use them. This paper will report the results of a study that looked at a first semester organic chemistry course for pharmacy majors in which the instructor made a conscious effort to break free from a traditional lecture format. Using qualitative methodology, we will address three topics that were covered during the semester to answer three key questions- **what** was done?, **how** was it done?, and most importantly **why** was it done?

Lucy, Edward C. **Session 13.02** **Sunday, March 23, 1997**
2:30pm-3:30pm
Cermak

A Responsive Constructivist Evaluation of A Self-Guided Activity Trail

Ted S. Wansley

A formative evaluation was done on a Self-Guided Activity Trail (SGAT) at the Cochran Mill Nature Center in Fairburn, Georgia. The prototype SGAT included features intended to engage visitor attention. The purpose of the evaluation was to determine which SGAT features influence visitor attention, what impact these features have on the intrinsic motivation of visitors, and to collect visitor recommendations for improving the SGAT. The methodology, adapted from Guba and Lincoln's responsive constructivist evaluation, utilized established naturalistic methods and hermeneutic dialectic negotiations. Participant-evaluators included nine high school student volunteers The study consisted of four phases: the client contact phase; individual construct phase; within-group construct phase; and the joint negotiation phase. As salient constructs emerged during these phases, they were organized in a construct table. Results identified nine SGAT attributes which increase visitor attention: hands-on opportunities; questions/problems; feedback at the next station; questions/problems at right level; hints; novelty/variety;self-guidedness; group size; and the scavenger hunt game. Each of these attributes stimulated a unique set of intrinsic motivation outcomes. Participants organized these outcomes into eight categories: activity, curiosity/interest; competence/ease; challenge; belonging/interaction; control/freedom; fairness; and competition. The results also revealed five attributes which decreased visitor attention. Nine recommendations emerged for improving the SGAT.

Lumpe, Andrew T. **Session 17.08** **Monday, March 24, 1997**
10:30am-12:00pm
Regency B

An Analysis of Current Middle School Science Curriculum Programs

Jodi J. Haney

This curriculum analysis was conducted to address the following goals: 1) to provide descriptive information; 2) to determine coverage of content strands from the National Science Education Standards; and 3) to determine the level of science inquiry in popular middle school science programs. The programs chosen for the analysis were: *Science Interactions*; *Science Plus*; *Macmillan Science*; *Prentice-Hall Science*; and *Middle School Science and Technology*. Seven National Science Education Standards content strands were used as categories for analyzing the programs. To determine the inquiry level of laboratory activities, the Modified Laboratory Analysis Inventory (LAI) was applied to a sample of the laboratory activities. Each analyzed textbook contained numerous inquiry activities for students to perform. However, the Modified LAI analysis revealed that many of the activities do not foster higher level inquiry skill development. All of the analyzed programs demonstrated a balanced coverage of life, physical, and earth/space science discipline-based content strands. Smaller proportions of the programs were devoted to science and technology, science in personal and social perspectives, and history and nature of science strands.

Lyons, David **Session 12.09** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook IV

An Investigation of the Use of the WWW for Sustained Inquiry in a Science Classroom

Joseph Hoffman **Joseph Krajcik** **Elliot Soloway**

Over the past decade the World Wide Web has grown from a small network of computers to an amazingly large and complex system. Science Educators have recently recognized the potential this media may have in supporting sustained inquiry. However, access to various on-line resources and curriculum materials alone does not suffice in providing the guidance students require to effectively ask questions, plan searches, design investigations, analyze the results of their inquiries, and create products. This paper explores student behavior and the strategies they employ while interacting with materials and the variety of digital resources available on the World Wide Web. Based on our work with middle and high school science students, we provide a profile of how students use on-line resources and the corresponding strategies they employ while engaged in sustained inquiry. Our work indicates that we must help students develop purposeful planning, searching and analysis skills to effectively take advantage of this new media. We provide suggestions for developing appropriate curricula tools and scaffolds to promote the successful use of the vast array of emerging digital resources.

Magnusson, Shirley J. **Session 16.02** **Monday, March 24, 1997**
8:30am-10:00am
Kent 1,2,3

Examining Communities of Practice as a Professional Development Model to Promote Guided Inquiry Science Teaching in the Elementary Grades

Annemarie S. Palincsar **Danielle Ford** **Nancy Brown**
Nancy Marano

The purpose of this conceptual paper is to describe a new approach to supporting teacher development derived from participation theory and a sociocultural orientation to learning. This approach, a community of practice model of professional development, fosters the development of teaching practice by creating a context in which teachers learn as they collaborate with other teachers – some of whom are also researchers and all of whom bring diverse expertise to the teaching/learning process – in the context of carrying out their responsibilities in classrooms and schools. The goal of our current effort is to foster the development of science teaching practice for elementary school teachers. A main feature of the project is the examination and use of a heuristic representing Guided Inquiry science instruction, which is an inquiry-based orientation to teaching science to elementary school children. In this paper, we describe the theoretical framework guiding this work and the program that we planned as a result. We also discuss the resulting program, focusing on the activities that seemed particularly instrumental in supporting community growth and development and teacher development. Finally, we comment on the utility of this model as an approach to professional development.

Maor, Dorit **Session 6.04** **Saturday, March 22, 1997**
10:30am-12:00pm
Cermak

Formative Evaluation of a Multimedia Program Using an Interpretive Methodology

This paper describes a formative evaluation that was conducted during the development of a multimedia package. The feedback provided by teachers, during a workshop session, by students interacting with the package, and by peers at a university, provided rich sources of information that were used to improve and modify the program. The multimedia package is based on the *Birds of Antarctica* database that uses authentic data collected during research expeditions to Antarctica and its design is guided by a constructivist approach.

Marbach-Ad, Gili **Session 14.07** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency B

Students' Conceptions in Genetics

Ruth Stavy

Genetics is one of the main issues in the life sciences. It seems that students have difficulties in understanding some of its basic concepts. This study examines: 1. students' understanding of concepts such as DNA, gene and chromosome; 2. students' understanding of the relationships between the following six pairs of concepts: gene-protein, gene-enzyme, gene-trait, DNA-protein, DNA-enzyme, DNA- trait. One hundred sixty-four 9th grade students in junior high school and one hundred 12th grade students, who study biology as a major subject in high school responded to a pencil and paper questionnaire (immediately following instruction) concerning the above questions. Forty-one other students, of the same ages, were interviewed and asked to prepare a concept map. The majority of students from both groups failed to understand and relate between concepts. Most of them made a compartmentalization between DNA and gene: DNA was described as an information flow **between** generations and gene as an information flow **within** generations. The results and their significance to science education will be discussed.

Marlow, Michael P. **Session 3.02** **Friday, March 21, 1997**
7:00pm-8:30pm
Butterfield

The Impact of Coursework in Constructivistic Inquiry on Pre-Service Elementary Teachers' Choices of Instructional Strategies

The purpose of this study is to examine the impact of coursework activities, designed from a constructivistic-inquiry viewpoint, on the changing attitudes and behaviors of a group of pre-service elementary teachers in their choices of instructional strategies. The class consisted of a series of exploratory indoor and outdoor activities, where the pre-service teachers participated in a series of connected investigations supported by the course instructors' modeling of scientific inquiry. 97 pre-service teachers, enrolled in two sections of the course, participated in the study. Data were collected from curriculum documents designed by the pre-service teachers to be used during clinical teaching, student reflection papers produced during the course, field notes from observations of their clinical teaching, and interviews with the pre-service teachers. Two questions guided the investigation: 1) What were the pre-service teacher's views of science and how students acquire knowledge in a classroom; 2) Did the experience of participating in actual scientific inquiry in the methods course motivate the pre-service teachers to do more inquiry-based science during their clinical teaching.

Marlow, Stacey E. **Session 16.03** **Monday, March 24, 1997**
8:30am-10:00am
Oak Brook I

Suddenly a Science Teacher: Understanding the Transition through Socialization

Callahan, Angela

This study examined the experiences and decision-making processes of a middle school teacher assigned to teach science outside of her certification area in a new school. Data were collected from: (a) interviews with the teacher-subject, (b) field notes of observations of the teacher-subject, (c) interviews with students and the teacher-subject's principal, (d) a journal kept by the teacher-subject and, (e) letters to friends and relatives sent by the teacher-subject and voluntarily shared with the researcher. Data analysis was done collaboratively by the teacher-subject and researcher, using biography and cognitive theory as a framework to analyze the socialization process. Findings indicated that the teacher's understanding of her life experiences, and her awareness of the socialization process helped her overcome negative aspects of organizational socialization; pedagogical knowledge and a strong sense of herself as a teacher helped her create an identity as a science teacher; and the teacher developed greater self-awareness as a result of the study that influenced her decisions about planning, instruction, and student evaluation.

Martin, Laura M. **Session 13.02** **Sunday, March 23, 1997**
2:30pm-3:30pm
Cermak

Does Narrative Belong in a Science Center?

Rosemary F. Leary

To investigate the idea of using narrative as a way to attract diverse audiences to a science center, a science center located in the southwest undertook an exploratory study. Specifically, they investigated how interdisciplinary, interpretive materials might be used to interest visitors who might not otherwise be interested in exhibits with science content and how these materials might be used to increase visitors' understanding and recall of exhibit content. To accomplish this purpose a team of experts was convened to review key questions about the use and structure of narrative, to develop a strategy and range of approaches to storytelling, and to develop ideas for story premises and texts. This group was subdivided into teams each representing one audience segment, e.g. Hispanic, Native American, etc. Finally, group interviews were held with potential visitors to learn how the ideas for materials generated by the experts might promote engagement in and awareness of science. The study demonstrated the strong, but not necessarily positive, feelings many have toward science and science centers. It also suggested that narrative might be one way to change those feelings.

Martins, Isabel **Session 13.09** **Sunday, March 23, 1997**
2:30pm-3:30pm
York 1,2,3

Visual Communication in the Learning of Science

Gunther Kress **Jon Ogborn** **Kieran McGillicuddy**

How do images contribute to the communication and learning of scientific concepts? During this ESRC funded project we have documented a variety of visual materials used as resources in high school teaching in the UK such as: school science text-books, published and teacher-generated worksheets, pupils' class and homework tasks, posters, models, etc., and observed science lessons to learn more about how visual materials are used in classroom activities. In this talk we present an analysis of the roles of visual communication in science texts and their influences on science education, discussing not only *how well students learn* from them but also *how images work*, so as to begin to describe their principal resources for making and combining meanings and to consider the nature of the interaction between the verbal and the visual in communication.

Mason, Diana **Session 3.03** **Friday, March 21, 1997**
7:00pm-8:30pm
Windsor

Gateway to Success for At-Risk Students in a Large-group Introductory Chemistry Class

Seventeen of 36 students from the Gateway and Success Programs at The University of Texas at Austin were placed in a typical large-group lecture of 200+ students. The remaining 19 "at-risk" students studied introductory chemistry in a small-lecture class designed especially for them. Each group of students received the same lecture material from the same instructor for the semester, and the same assignments were completed by all students. Results indicate that a smaller-sized class did not affect academic success in introductory chemistry when collaborative teaching techniques were used with both groups. The collaborative problem sets were completed by all students on an individual basis and consisted of paired algorithmic and conceptual problems reflective of the topics generally associated with beginning chemistry. Because of the informal setting, it is possible that students experienced scaffolding in the larger lecture thereby enhancing their chance of success.

Matkins, Juanita Jo **Session 6.03** **Saturday, March 22, 1997**
10:30am-12:00pm
Spring Room

Scientist, Daughter, Wife and Mommy: Enabling Factors in the lives of Six Contemporary Women Scientists

This qualitative study was conducted over a two-year time span to determine the enabling and potentially disabling factors in the lives of six women scientists. The participants were two astronomers, a meteorologist, a forensic pathologist, a physicist/astronaut, and a geologist. Individual semi-structured interviews were conducted, resulting in case studies. The single most decisive enabling factor in the development of these women was the emergence and maintenance of a sense of possible-self-as-a-scientist. A primary supporting factor for this sense was the implicit and explicit encouragement of birth families. Other factors which supported this sense included education in single-sex schools, and an expectation of financial responsibility. Potentially disabling factors included situations which were disruptive to young families, and paternalistic and sexist attitudes of academic and research institutions. The results showed a need for recognizing and including families in efforts to bring females into science careers, as well as respecting and supporting the choice many women are making - to be wives and mothers as well as scientists.

Matthews, Michael R. **Session 7.04** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook III

Pendulum Motion and Solving the Problem of Longitude: How History Might Contribute to Science Education

Correct analysis of pendulum motion in the early 17th century, and the subsequent development of the pendulum clock, was at the heart of the Scientific Revolution. As the Newtonian scholar, Richard Westfall, has remarked that "The pendulum became the most important instrument of seventeenth-century science, and not just as a timepiece...without it the seventeenth century could not have begot the world of precision...there has not been a more fundamental change in the history of Western thought." And the pendulum was also crucial to the Industrial Revolution. Lewis Mumford has commented that "The clock, not the steam-engine, is the key-machine of the modern industrial age." The pendulum was the solution to the long-standing, and richly-rewarded, problem of determining longitude in exploration – something that opened the world to Western commerce and colonisation. My argument will be that more of the pendulum story should be told in standard physics courses on the subject. If this were so then physics would be more interesting, and students would gain a better appreciation of the nature of science and its interrelations with society. Further such an historical approach ideally suits the desire to make coherent connections across school disciplines.

McClafferty, Terence P. **Session 14.03** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook I

A Triangulation Strategy to Measure Children's Learning Outcomes from An Interactive Exhibit

Léonie J. Rennie

This paper reports part of a larger study into children's learning during visits to an interactive science–technology centre. Its purpose is to demonstrate how a variety of data collections methods were used in an attempt to capture the complexity of the learning environment in the centre, as well as the uniqueness of the individual. The study used different types and methods of data collection for triangulation of data, method, and investigator. Data triangulation was accomplished by collecting data from children of different ages from nine schools of different social economic status. Two persons interviewed the children and examined the data, providing investigator triangulation. Methodological triangulation was achieved by using different modes of data collection, including interviews, observation, video-recording and children's drawings. There was considerable congruence among the findings from the different data sources, but there was also different new information obtained from each, enabling a more comprehensive view of children's learning experience to be obtained. The results demonstrate the importance of using triangulation of methods and data sources to enhance understanding of the measurement of learning from an exhibit.

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McComas, William **Session 12.08** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook III

An Assessment of Student Perceptions of the Actual and Ideal State of Undergraduate Laboratory Instruction

Hsingchi Wang **Linda S. Bazilian**

This proposal represents an interim report of a larger scale study of student perceptions and preferences of their undergraduate laboratory experience. A new instrument was designed to answer questions about the kind of students participating in undergraduate science laboratories, their attitudes about such experiences, the goals they perceive for instructional laboratories and their preferences regarding particular instructional strategies. The questions in the preferences section are based on an exemplary practice model which describes thirteen research-based strategies to enhance laboratory learning. The survey was field tested and modified before administration to 93 students in three different types of high education institutions. The resulting reliability values as determined by coefficient alpha for each section ranged from 0.69 to 0.84 with the overall reliability of 0.83. As an interim conclusion, we can state that students generally recognized each of the five broad goals typically associated with the laboratory as present in their laboratory experiences, but that no goal was rated at the highest value as a major aim of the instructional laboratory. More interesting were the perceptions and preferences exhibited by students toward the elements of exemplary laboratory instruction. A discrepancy calculation was performed and student response frequencies were ranked for analysis.

McGinn, Michelle K. **Session 8.08** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency B

Student Understandings of the Balance Beam: Variations Within and Across Contexts

Wolff-Michael Roth

Producing and interpreting graphs is a central practice in the scientific community, and learning this practice is an important aspect of moving from being a biology student to becoming a biology researcher. This study was designed to help us better understand the ways college students learn to interpret graphs. Particular attention is paid to interactions between students and the resources they used to make their interpretations. Student discussions of problem sets assigned in an undergraduate ecology seminar were videotaped and transcribed. Resources used by the students included prior discourses developed in biology and mathematics, comments remembered from lecture, readings of problems and instructions, and questions directed to the teaching assistant. To interpret graphs, students used resources that we conceptualized as ranging from "direct" to "near-indirect" to "far-indirect" indicating the degree of conceptual relationship to the problem being addressed. These resources both helped and hindered students as they interpreted graphs and their relation to ecology 'in the field.' We conjecture that more opportunities for small groups of students to discuss the use of different resources in interpreting graphs would assist them in developing graphing-related competencies that exceed those which they presently attain.

McGinnis, J. Randy **Session 12.07** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook II

Development of an Instrument to Measure Teacher Candidates' Attitudes and Beliefs About Mathematics and Science

Tad Watanabe **Gilli Saama** **Anna Graeber**

This session describes the development and use of a valid and reliable instrument (n =486, =.76) to measure teacher candidates' attitudes and beliefs about the nature of and the teaching of mathematics and science. The instrument, Attitudes and Beliefs about the Nature of and the Teaching of Mathematics and Science, was developed for the Maryland Collaborative for Teacher Preparation [MCTP], a National Science Foundation funded undergraduate teacher preparation program for specialist mathematics and science elementary/middle level teachers. Sections of the instrument that were verified by factor analysis dealt with beliefs about mathematics and science; attitudes toward mathematics and science; beliefs about teaching mathematics and science; attitudes toward learning to teach mathematics and science; and attitudes toward teaching mathematics and science. Within the MCTP, the survey instrument has proven to be useful as we attempt to landscape the paths the MCTP teacher candidates travel during their undergraduate years. Outside the MCTP, this survey instrument is offered as a valid and reliable tool to measure teacher candidates' attitudes and beliefs about the nature of and the teaching of mathematics and science.

McGinnis, J. Randy **Session 13.08** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook IV

Teaching Science Methods to Women: Three Tales of Men Professors Reflecting on Their Practices

Kenneth Tobin **Thomas R. Koballa, Jr.**

This interactive session offers the perspectives of three men professors, all of whom teach science methods to classes consisting primary of women prospective teachers, who have engaged the matter of gender inclusive education in their classrooms and who have struggled with the ramifications of that engagement. It is a common insight that men professors approach women issues from a distinct point of view. This is a point of view that we have gained through the interaction of influences from our families, friends, teachers, professional literature, and social context in which we have lived. The panelists share insights they have gained from investigating gender dissonance within their personal professional lives which cover different institutions of higher learning and time periods. The goal of this session is to provide the basis for conversation about men science education professors, gender inclusive education, women prospective science teachers, and avenues of research to construct a more complete understanding of the situation.

McGlamery, Sheryl **Session 12.04** **Sunday, March 23, 1997**
10:30am-12:00pm
Hunt 1,2,3

Program Influences, Change and the Mediating Influences of School Culture: Development of New Science Teachers

Doug MacIsaac

The focus of this research study was to describe the issues and influences of teacher preparation and school culture as experienced by new science teachers in their first three years of teaching. Twelve new teachers were followed through a three year period. The Findings of the study show the (1) nature of the pre-service program influence, (2) the limited nature of prior field experience, (3) the major influence of prior beliefs and attitudes held by new science teachers, and (4) the profound influence of the school culture where they were given their first teaching positions.

McMahon, Maureen **Session 10.07** **Saturday, March 22, 1997**
4:00PM-5:30pm
Oak Brook IV

Play and Emerging Scientific Literacy

Nancy W. Wiltz Christine M. Kelly Gregory R. Potter

The purpose of this study was to investigate the role of free-play in the emergence of scientific literacy in a kindergarten classroom. The activities, experiences and discourse of 150 Kindergarten children were explored as the children were offered freely chosen opportunities to incorporate scientific laboratory tools and the language of science into their free play over a six month period. Data were collected on choice of play setting, duration of play, choice of play toys, play dialogue, and gender and ethno-cultural differences during play. Significant differences arose in the actions and dialogue between the children in the treatment and control classrooms as they were observed playing with the science equipment during post-treatment play ($p<0.05$). Moreover, treatment students were involved in high level dramatic play which included role-playing of scientists in a laboratory, mad scientists creating new potions, doctors discovering cures for diseases. Through an introduction to a science activity and the naming of equipment and symbols which surrounded the activity, children freely chose the opportunity to explore science through play. The dramas they created, with intricate plots, and richly woven dialogues surrounding science themes, were more complex, abstract, and exciting than any textbook's science activities designed for the young child.

McRobbie, Campbell J. **Session 8.10** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency D

Research Involving Personal Forms of Learning Environment Instruments

Darrell L. Fisher

Traditionally, learning environment researchers assumed that there is a unique learning environment that all students in a class more or less experience. However, the assumption of a common learning environment experienced by all students within a classroom was challenged in the latter half of the 1980s in interpretive studies employing classroom learning environment instruments, classroom observations, and interviews of teachers and students. Therefore, there is potentially a problem when studying differences between groups of students in a classroom (e.g. boys and girls) because these instruments elicit the student's perceptions of the class as a whole rather than the student's personal perception of his or her role in that classroom. Consequently, a Personal Form of two learning environment instruments was developed to assess students' personal perceptions of their role in the environment of the classroom rather than their perceptions of the learning environment in the class as a whole (Class Form). It was found that (1) average student perceptions on the Class Form were more favorable than average student perceptions on the Personal Form and (2) the magnitudes of outcome-environment associations were similar for Class and Personal Forms, but commonality analyses showed that the Class Form and the Personal Form each was associated with unique variance in outcomes that was independent of the other form.

Meadows, Lee **Session 6.12** **Saturday, March 22, 1997**
10:30am-12:00pm
Windsor

Undermining Learning: Students And Science Teaching In An Urban School

The purpose of the study was to develop grounded theory from reflections on a year's experiences of teaching one day per week in an urban school. Open, axial, and synthetic coding revealed a dysfunctional interaction pattern between students, teachers, and the educational system, a compromise that undermined students' learning. Teachers appeared to have power to improve the learning of at-risk students through high, realistic expectations, effective pedagogy, and culturally-situated classroom management. Mentoring and a period of enculturation were also necessary for effectively moving into the culture.

Melear, Claudia T. **Session 3.03** **Friday, March 21, 1997**
7:00pm-8:30pm
Windsor

Knowledge and Incidence of Domestic Violence Among Elementary Science Methods Students

Science educators consider the prior experiences and cultural contexts of the learners. Equally important is that we view our preservice teachers in exactly these same constructivist contexts. Melear (1995) suggests a curriculum framework which includes domestic violence as one multicultural topic in biology and in science methods courses. Toward that end, during the semester in which the O. J. Simpson trial was decided, a three question survey was anonymously and voluntarily conducted in two elementary science methods classes (n=40) on the students' knowledge, experience with and perceptions of domestic violence. The topic of domestic violence had never been mentioned in the class previously. Stark & Flitcraft (1992) report that domestic violence is responsible for more than half of the injuries women present in health care facilities, a number which they report is more than three times the number of automobile accidents. Results of this study showed that 1. almost half of the students had personal knowledge of domestic violence and 2. more than twice the number than in the general population (Center for Disease Control, 1996) had been physically abused themselves. One student reported that many women do not consider hitting or slapping domestic violence when the husband is angry or has been drinking. The preservice elementary teachers indicated that they would provide education to their students about domestic violence if such a curriculum for teachers were available.

Middlebrooks, Sally **Session 10.07** **Saturday, March 22, 1997**
4:00PM-5:30pm
Oak Brook IV

Signs Saying "Under Construction": Children's Worldmaking in an Urban Environment

The purpose of this research was to understand how children who live in an economically poor urban environment describe what they do and play on their own when school's out; specifically, the 3-dimensional structures they build in small apartments, and outside, in playgrounds, on stoops, and in vacant lots. Methods for this study included open-ended interviews and drawings and photographs made by the children. It is likely that all children, and, in particular, children who traditionally do not perform well in school, are disadvantaged by the failure to acknowledge and value how smart they are in their daily lives. By paying attention to what children do and play outside of school, educators build on important aspects of children's lives, knowledge, and abilities.

Minch, Sherrill L. **Session 16.04** **Monday, March 24, 1997**
8:30am-10:00am
Regency A

Individual Classroom Variation in the Implementation of Pasadena's District-Wide Hands-on Science Curriculum

James M. Bower

Pasadena Unified School District has created a district-wide, hands-on elementary science program which includes four curriculum units for each grade level, extensive teacher training, complete materials kits for each unit, and resource teacher support. This research examined to what extent the district-specified curriculum was being implemented in classrooms and explored how the implementation of the curriculum varied from classroom to classroom. A single curriculum unit was the focus of this study. A survey was used to determine which lessons from the unit were being presented by the teachers to their students, and classroom observations of entire science lessons were conducted to explore variations in teachers' presentations of specific lessons. Additionally, a structured descriptive analysis system was used to analyze multiple lesson transcripts from each teacher to investigate variations in individual teachers' overall presentation styles. More than 40% of the teachers teaching this unit were observed for four or more lessons. Analysis of the data revealed a significant amount of commonality in which lessons from the curriculum were presented and in how specific lessons were presented; at the same time, there was considerable lesson-to-lesson and teacher-to-teacher variability in the implementation of the curriculum.

Mistler-Jackson, Megan **Session 10.11** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency D

Student Achievement and Experience in an Internet-Based Project

The Kids as Global Scientists (KGS) project, funded by NSF, engaged students in the study of atmospheric science through the use of real-time satellite imagery and on-line peer and scientist communication. This case study examined one sixth grade classroom of KGS participants during the eight-week 1996 Exchange. Six students representing three confidence levels were selected for extensive study to determine how the project impacted various types of students in terms of content learning and motivation. Pre and post test scores were analyzed for the entire class and the six students' comments from pre and post interviews served as voices for each confidence group. Results indicated that students made significant gains on the post test in terms of weather content knowledge. Interviews revealed a high level of student motivation and satisfaction with the project.

Monhardt, Leigh **Session 6.05** **Saturday, March 22, 1997**
10:30am-12:00pm
Harger

An Examination of Gender and Retention Issues and Implication in GER Science Classes

Don Wick

The goal of this investigation was to examine the attitudes and perceptions of students toward the science courses they take. Students from a Human Biology GER course were given a written survey focusing on their attitudes and perceptions of the course and reasons for taking it. The survey instrument was designed from modifications of widely used surveys in education with a Likert scale response format. Survey analysis implicated a difference in student attitude and perception towards GER science courses. The demographic information obtained, i.e. gender, major, age, could have implications on instructional strategies.

Monhardt, Rebecca M. **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

A Comparison of Teacher Attitudes Toward Writing In Science and the Writing Activities Students Do

The purpose of this study was to determine the kinds of writing being done in science classrooms and to examine teachers' attitudes toward writing. A survey instrument was sent to 309 randomly selected elementary, junior high and high school science teachers from across the United States. The survey listed twelve types of writing commonly done in science classrooms. Using a five point Likert scale, teachers were asked how often they used each of the items on the survey. Teachers were also asked whether or not they considered writing an important way to learn science content and to explain their rationale for the kind of writing they had students do most often. Results indicated that the writing being done in science classrooms showed what students had already learned rather than helping in the learning process itself. Teachers saw the benefits that writing had to offer as a tool for learning but were not using it in a way to achieve this goal.

Morais, Ana **Session 6.07** **Saturday, March 22, 1997**
10:30am-12:00pm
Kent 1,2,3

Is There Any Change in Science Educational Reforms? - A Sociological Study of Theories of Instruction

Isabel P. Neves

This paper refers to the relation teacher-student in the science classroom of the 5th/6th and 7th years of schooling and its objective is the analysis of the learning theory legitimized by the Ministry of Education in the present reform (1991) by comparison with the precedent reform (1975), in order to find out possible changes in the teacher-student relation. The study is theoretically based on Bernstein's theory and it is focused on the analysis of power and control relations underlying given syllabuses. In the analysis we used the sentence as the unit of analysis and all syllabuses' sentences were analysed. A qualitative/interpretative methodology of analysis was followed. The results showed that for the 5th/6th years of schooling the learning theory legitimized in 1975 was centered on the acquirer, whereas in 1991 was centered on the transmitter. For the 7th year, the results show that, in both reforms, the learning theory tends to be centered on the acquirer although less so in 1991. Differences from 1975 to 1991 reveal a change from a more self-regulative learning to a mixed theory. This is particularly evident for the 5th/6th years of schooling.

Morrell, Patricia **Session 3.09** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook IV

Inservicing Science and Mathematics Teachers: A Model that Works!

David Curry

The Math/Science Teachers Improvement Project (M/STIP) is a "teachers teaching teachers" program which focuses on in-service development for improved classroom instruction. The target audience is K-8 teachers. The project has been evolving for the past decade, being guided by educational research, experience, feedback of participants, and local needs. The biggest strengths of the program are the composition and empowerment of its teacher leadership team, an emphasis on modeling and hands-on activities, and the scheduling of meetings throughout the school year. Based on quantitative and qualitative reports from the teachers served by M/STIP, this model is successful in not only strengthening the content knowledge of the participants but also in changing the teachers' classroom behaviors.

Moscovici, Hedy **Session 10.02** **Saturday, March 22, 1997**
4:00pm-5:30pm
Hunt 1,2,3

Measuring Differences Between Ecosystems: Task Dynamics in a College Biology Course for Prospective Elementary Teachers

This study explores the dynamic profile of task as interpreted by prospective elementary teachers enrolled in a college biology course. Tasks changed from the planned or intended task (as defined by the instructor before implementation and presented to the students during the field trip), to the transitional or technical task (influenced by the list of materials available and on-site conditions) to the enacted task or tasks (tasks that were actually performed by the different students). The planned or intended task had the potential to involve students in an integrative problem-solving experience that combined concepts from science (e.g., influence of elevation level on vegetation), mathematics (e.g., relationships between sides and angles in a right-angle), and technology education (designing and building a device in order to find the relative elevation). Findings show that only some of the students in the group attempted to solve the planned or intended task (finding the elevation). Most students got involved in the transitional task - trying to figure out how to use of materials and equipment. Because of time constraints students chose to find the technical solution from the instructor, perform the measurements, and fill the work-sheet.

Muire, Willis C., Jr. **Session 16.04** **Monday, March 24, 1997**
8:30am-10:00am
Regency A

Curriculum and Policy Reform (CPR) in Florida: Conservative Populist Rhetoric or Critical Progressive Restructuring?

In the past several years, FSU faculty have undertaken several statewide studies to ascertain the needs of K-12 teachers of mathematics and science in relation to their accounts of what they are doing. This paper examines state level curriculum reform efforts through data that are derived from the most recent component of these longitudinal studies, an evaluation of elementary teacher needs in mathematics and science education. The primary data sources are teacher questionnaires, interviews of government leaders, elementary classroom observations, teacher inservice workshops, and a thorough document analysis. The results reveal that teachers' needs are interrelated with the social system in which they live and work. There is ample evidence to support the assertions that curriculum reform Florida is stalled, if not getting worse, particularly in elementary science education. The reasons for this slide are numerous, but from a statewide perspective, there appears to be a lack of consistency among the array of policies emanating from the State that impact upon the enacted curriculum. Schools are receiving mixed signals concerning state requirements in the content areas, and due to the myriad of other tasks being required of them, often allow science to fade into the background of priorities.

Muire, Willis C., Jr. **Session 17.09** **Monday, March 24, 1997**
10:30am-12:00pm
Regency C

Non-Traditional Forms of Assessment in University Science and Science Education Courses

Abdullah Abbas **Penny Gilmer** **Nancy Davis**

FSU faculty from will discuss the implications of using non-traditional forms of assessment in science and science education courses at both the graduate and undergraduate levels. Instructors (Physical Science for Elementary Teachers) incorporated the use of personal journals, hands-on exams, and group projects as course requirements in an effort to ascertain the areas of strength and weakness that students were experiencing while attempting to understand science content. Muire and Abbas will examine the use of personal journals in this course and the impact that these alternative forms of assessment have had with respect to the views of the students and the professors who assigned them. Dr. Penny Gilmer has pioneered the use of contextual learning projects associated with current scientific research in several graduate and undergraduate chemistry courses at FSU. For example, during Fall '95, two undergraduate seniors completed an in-depth study on the auto immune disease, lupus. In addition, Dr. Nancy Davis will discuss her research in the use of and dialogic journals as requirements in graduate level science education courses. Participants will present for an average of 10-15 minutes each. The remaining bulk of time will be reserved for interactive discussion with the audience.

Muire, Willis C., Jr. **Session 7.06** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency A

Elementary Science and Mathematics Teacher Needs and Educational Reform in Florida

This study examines data gathered from an elementary teacher survey distributed to K-5 teachers in 30 of 67 counties across Florida. Teachers were asked to respond to a series of questions that addressed their teaching practices in mathematics and science. In addition, they were invited to write about their most significant teaching needs. These reported needs provided the primary data source for this study. This information consisted of a database of 4,458 comments from K-5 teachers in Florida. In considering the needs of Florida's elementary teachers in terms of curriculum reform, we examined evidence about teachers' knowledge and beliefs regarding what they perceive to be constraints to their teaching. Findings indicated some disturbing trends in the incorporation of hands-on experiences, community involvement, and allocation of resources, to name a few. Results also revealed that the expressed needs of teachers are interrelated with the social system in which they live and work. There is considerable evidence to support the assertion that the curriculum reform envisioned by *A Comprehensive Plan for Improving Mathematics, Science and Computer Education in Florida* (1989) is stalled, if not getting worse, particularly in elementary science education.

Naizer, Gilbert L. **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Science at Home: Where do Students Find It?

Numerous studies have examined students' definitions of science, their conception of the nature of science, and/or science misconceptions, few have examined what students perceive as science within their everyday lives. This study utilized a unique approach to examine elementary students' perceptions of science within everyday experiences in their homes and neighborhoods. Students were provided with single-use cameras and given the instructions: take pictures of science you see in your home and neighborhood, keep a list of the pictures you take, and explain why the subject of the photograph is science. The photographs and explanations were sorted and analyzed to identify patterns and differences. The most common categories of photographs were: technology, electricity, plants, chemistry, weather, animals, rocks/soil.

Narro, Martha L. **Session 16.01** **Monday, March 24, 1997**
8:30am-10:00am
Hunt 1,2,3

Science Teachers and the Master's Program They Select: A Preliminary Study

Jeanne Slaughter **Julie L. Wilson**

This study examined participants' perceptions about two master's programs: one administered by the College of Education, the other a General Biology program administered by three biological science departments. Four teachers from each program participated in open-ended interviews. Interviews were administered with the goal of allowing the participant to discuss his or her program in-depth. The eight interviews, lasting one to two hours, were transcribed and analyzed to provide information about the participants' perceptions of each master's program. Those in the Education program valued the flexibility regarding course selection and scheduling, and courses on educational research. They were seeking pedagogical content knowledge and viewed themselves as professionals in the broader teaching community. Teachers in the General Biology program valued science content courses, doing science research and interacting with their peers. They reported a gain in professional and personal confidence and felt they had changed their classroom instruction. This study reveals that each master's program contributes differently to the professional development of secondary science teachers and that neither program fully meets the teachers' needs. Our study suggests that education and science faculty should collaborate to provide master's programs which include courses and research experiences in both education and science.

Nason, Patricia L. **Session 9.07** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Teacher Interns Experience Alternative Views of Knowledge Acquisition

The purpose of this study was to examine at one teacher educator's attempt to encourage teacher interns to examine their perceptions of how one learns and how teachers should teach from the constructivist point of view. Activities in an elementary science methods course were meant to guide teacher interns in their understanding of knowledge acquisition within a science framework by experiencing and practicing methods using the constructivist perspective. Most of the data was analyzed using analytic induction and the constant comparative method.

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Neto, António J. **Session 10.09** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency B

Problem Solving in Physics: Towards a Synergetic Metacognitively Developed Approach

Maria Odete Valente

Based on writers like Vygotsky or Kelly, there are some theoretical reasons to believe that instead of predominantly concerned with their students' quite problematic change of conceptual ideas (with content), physics teachers should put a greater concern on the thinking process, that is, on problem solving ability, moving from the typical formulaic, quantitative orientation to a more qualitative, metacognitive approach. This study refers to an investigation designed precisely to examine whether it might be possible to derive such classroom approaches. The empirical part of the research was carried out in the field of physics, at two Portuguese high schools. Both qualitative (interviews) and quantitative research procedures were used. The quantitative dimension took the form of a five-month quasi-experimental *versus* control design, involving tenth grade students. The analysis of data seems to indicate significantly higher progress for the experimental pupils as contrasted with their control peers, in what some metacognitive problem solving abilities are concerned; less significant differences regarding qualitative conceptual and attitudinal change were displayed. Our claim that a metacognitively oriented problem solving approach might be a suitable mean to assure a synergetic interaction between the scientific concepts and the thinking skills seems to have acquired considerable support.

Newhouse-Maiden, Lesley **Session 16.07** **Monday, March 24, 1997**
8:30am-10:00am
Regency D

Women Engineering Students' Views of the Gender-Sensitivity of their Science Teachers

Lesley H. Parker

In this study we focused on 45 women Engineering students in two Australian universities. The objective was to obtain, from the women's reflections, an indication of the extent to which their schoolteachers, especially their science teachers, had provided gender-sensitive environments which supported their choice of a career in engineering. Over a five-year period (1992-96), we developed a life history of each of the participants, using a narrative approach, within which the concepts of "career" and "career development" (Super, 1990) were central. The women were encouraged to comment on the extent to which teachers at various stages of their education had provided support and learning environments which were sensitive to their needs, talents and preferred ways of knowing and information processing. During both the growth and the exploration stages of the women's career development, it was apparent that their teachers, especially their science teachers had played a role that went well beyond the immediate pedagogical concerns of the subject being taught. It was also clear that positive attitudes towards science and engineering could be negated by negative experiences in Engineering studies. Thus, as Davis et al (1996, p. xii) have noted, "To change opportunities for women in engineering and science, we must focus... on the role of higher education."

Nichols-Thompson, Sharon E. **Session 14.10** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency E

Generating Prospective Elementary Teachers' Personal Understandings about the Phenomena of Science Teaching and Learning

Deborah Tippins

This study explores how the use of a tool, learning maps, facilitated prospective elementary teachers' critique of their views of science and contributed to the development of teachers' beginning points for teaching science. Learning maps, in this study, are considered to be a form of narrative knowing which serves as a powerful pedagogical tool for representing aspects of teaching and learning. Secondly, this study poses a theoretical basis for examining dialectical relationships between elementary teachers' sense of epistemic agency and culturally generated views of science teaching. Questions guiding this study include: 1) What perceptions do prospective elementary teachers have of 'science'? 2) What situations have shaped their constructed views of 'science'? 3) To what extent do these views of science pose viable ways of making sense of the world in everyday life? 4) How might the development of a personally viable science influence prospective teachers' visions of teaching science and what would such a science look like? Findings from this study explore prospective teachers' theorizing about science teaching and implications this has for the design of elementary science teacher preparation courses.

Niedderer, Hans **Session 8.08** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency B

Learning Pathways in High-School Level Quantum Atomic Physics.

Jürgen Petri

In this case study, we investigate an individual high school student's learning processes in the domain of quantum atomic physics. Our aim is to elaborate the student's 'cognitive system for atomic physics' as a hypothetical model to describe and explain his thinking and learning in interaction with the 'teaching input.' The model serves as a means to explain how and why students act the way they do in a certain instructional context. We illustrate first results by discussing two current hypotheses. First, we describe the student Carl's learning process concerning his conception of an atom as a conceptual growth. His final conception of an atom is a 'federation' of several connected conceptions including his initial planetary model as the point of reference. Second, there is a 'superior administration.' Carl is able to reflect on differences and advantages of each conception. This development is largely determined by Carl's epistemological beliefs and his personal attitudes towards physics and instruction. Changing Carl's model of the atom means more than changing a certain conception. It requires to change part of his personal identity.

Nielsen, Laura Wang **Session 12.03** **Sunday, March 23, 1997**
10:30am-12:00pm
Harger

Schools and Science Centres Working Together: An STS Issues-Based Approach to Science Learning

Erminia Pedretti

This paper examines the emerging roles of schools and science centres in portraying science in a contextualized, meaningful way; one that acknowledges the intimate relationship between scientific knowledge and social responsibility. In an attempt to bridge scientific knowledge with social responsibility, a social issues based approach to learning in science, technology and society (STS) education was adopted by two classroom teachers in concert with a science centre. In particular, the study examines: a) how young students (grades 5,6 and 8) make sense of controversial issues (in this context, the issue is mining); b) how an informal learning environment might provide a forum for conversation, debate and discussion around a contextualized STS issue, and how that conversation might be continued in, and connected to, students' experiences in their classrooms; and c) the building of connections and partnerships among schools and informal settings.

Nieswandt, Martina **Session 7.11** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency F

Meaningful Learning in Chemistry Classes through Original Writing

Language seems to be central for communicating and more importantly for understanding scientific phenomena. While class discussions have shortcomings like all spontaneous oral comments writing seems to be an instrument to complete, to extend and to permanently consolidate the process of knowledge and thinking. The questions of our study are whether writing helps students to learn science more meaningfully than traditional class discussion. If it does, how, and if it doesn't, why not. The aim of the empirical study is to test whether writing results in more meaningful science learning and better long-term recall. More than that, the analysis includes a look into the "black-box" to consider the exact ways in which students' writing changes. Our writing project was carried out in four 9th grade classes at the Gymnasium (secondary school). Four teaching units were covered in 30 lessons. The preliminary study indicates that writing may support under some conditions (motivation to write) a long-term consolidation of the lessons materials.

Norman, John **Session 12.10** **Sunday, March 23, 1997**
10:30am-12:00pm
Ogden

The Development of a Test of Knowledge about Biodiversity

Ajayi Olabisi

Teachers need to have accurate and up-to-date knowledge about biodiversity in order to help prepare world citizens to cope with the problem of decreasing variability on our planet. Do K-12 teachers have an adequate understanding of biodiversity? It is this question that provided the focus for this study. The objectives of this study were to: 1) develop a reliable and valid test of teacher knowledge about biodiversity; 2) administer this test to K-12 teachers to determine their current knowledge about biodiversity; and 3) determine how selected teacher demographic variables relate to test scores. The theoretical framework for the development of this test was based on the work of Otto T. Solbrig who classified knowledge about biodiversity into three levels of variability, namely: the ecosystem level, the species level, and the genetic level. These three levels of biodiversity are important for successful adaptation to a changing environment. The following conclusions were made in this study: 1) The Norman-Stevens Biodiversity Test is a valid and reliable test for measuring teacher knowledge about biodiversity; 2) Teacher knowledge about biodiversity is fairly poor for all three levels of biodiversity; 3) The number of environmental/environmental education courses taken by teachers has a positive relationship to their knowledge about biodiversity.

Norman, Obed **Session 8.12** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency F

Towards a Viable Constructivism for the Science Classroom

While constructivism has emerged as an important driving force in science education reform initiatives as well as in teacher education, there is every indication that very little constructivist pedagogy is being implemented by classroom teachers. This paper takes the position that operationalizing constructivism within school learning environments requires a reevaluation of constructivist epistemology in the context of the constraints within schools. This is because schools constitute very specific learning contexts. The paper examines some of the epistemological questions constructivists have to address in order to facilitate the implementation of constructivist pedagogy in schools. Theoretical framework for further exploration of the issues are also suggested.

Nott, Mick **Session 16.08** **Monday, March 24, 1997**
8:30am-10:00am
Regency F

The Good, the Speculative, the Vague and the Unique: Science Teachers' Stories

To celebrate its centenary the Association for Science Education (ASE), the largest subject teacher association in the UK, is going to hold a Science Teacher Festival at its annual meeting in January 2001 with an exhibition, associated events and publications to record the lives of science teachers. There will be a strong (auto)biographical component about people involved in the ASE through the century up to as close to the present as we can. We intend to emphasise the human aspects of what is involved in becoming and being a science teacher. The Science Teacher Festival should encourage reflection on how people have taught science in the past, how they have organised themselves to support the teaching of science and how this can critique the present and inform the future. The research raises methodological issues which the presenter wants all attending to actively explore and help with at this session. International expertise is welcomed in guiding this project. International contributions are sought for what we can learn from cross cultural comparisons.

Nyhof-Young, Joyce **Session 17.04** **Monday, March 24, 1997**
10:30am-12:00pm
Hunt 1,2,3

Action Research in Gender Issues in Science

This case study describes and analyses the experiences and outcomes of an Action Research Group established within a graduate course in education for science teachers at the Ontario Institute for Studies in Education (OISE) in Toronto. A small group of educators, originally comprised of the author and 5 other science teachers (2 of us in the elementary panel, 2 in the secondary panel, and 2 tertiary educators), met with the purpose of exploring problems and practices around gender in science education through action research within a mutually supportive group. Our experiences form the basis of the study. Using case study methods arising from ethnographic traditions, this paper examines the role of action research and small group work in creating an environment that encourages and enables teachers to learn effectively, and discusses the problems and dilemmas which confronted our small group. Issues related to project design, group dynamics and facilitator roles in action research will be explored.

Obenauf, Patricia **Session 17.14** **Monday, March 24, 1997**
10:30am-12:00pm
York 1,2,3

History and Development of Teacher Institutes at the National Radio Astronomy Observatory

Sue Ann Heatherly Eric J. Pyle

The purpose of this paper is to portray the history and development of a series of science teacher research experiences and to provide and overview of the impact of the research experience on their subsequent teaching practice. Since 1987, 20 institutes have been held at the National Radio Astronomy Observatory (NRAO) at Greenbank, WV. Inservice and preservice teachers participate in 1- or 2-week residential institutes where they investigate, in small groups, a generalized research problem using a 40-ft radio telescope. At the same time, they develop a deeper understanding of the scientific research process, in order to use the process as a model for science teaching. Since the inception of the program, a total of 276 participants have completed a total of 211 research-oriented instructional units in their classrooms. A total of 251 workshops have been offered by past participants, sharing their experiences with radio astronomy and a scientific research-oriented instructional model. The other papers in this set describe in detail the impact of the institutes on teachers and students, as well as the means of assessing the impact.

Odom, A. Louis

Session 9.09

Saturday, March 22, 1997
2:45pm-3:45pm
Regency A

Preservice Versus Inservice Teachers' Understanding of, and Confidence in Their Knowledge

Students taking the learning cycle test were requested to mark the level of confidence they had with each of their answers. When a student indicated that their confidence on a given item was eighty percent or greater, they were categorized as 'highly confident.' Comparisons were made between graduate and undergraduate students enrolled in similar science methods courses. Preservice teachers scored better on items related to the Exploration phase than did the inservice teachers whereas the inservice teachers performed better on items about the Concept Introduction phase. Scores on the Concept Application items were similar for the two groups. When results were tabulated for correct answers with which the respondents were highly confident, the two groups demonstrated dissimilar distributions across the test items. Undergraduates were more frequently confident in their wrong answers than were the graduates.

Ogonowski, Mark

Session 7.01

Saturday, March 22, 1997
12:00pm-1:00pm
Hunt 1,2,3

Learning and Teaching Science: Teacher Professional Development as Inquiry

Angelo Collins Charles Anderson

The goal of this session is to explore through a grounded discussion what teachers learn about science, teaching and learning when they conduct their own extended scientific investigations. The discussion will be centered around a video case study of one teacher's six-month exploration of aquatic ecology that took place within the context of a collaborative project involving science teachers and educational researchers. The video case study will be shown, and three discussants will briefly offer their perspectives as to how this case informs issues of teacher development in science. These presentations will be followed by a conversation among the discussants and audience.

Okebukola, Peter

Session 10.10

Saturday, March 22, 1997
4:00pm-5:30pm
Regency C

Promoting Problem-Solving in Science Through Concept-Mapping and Cooperative Learning

Olugbemiro J. Jegede

The problem-solving abilities of science students, further explored by gender, were examined under three learning environments - cooperative learning, concept mapping and cooperative-concept mapping. These three settings were compared with the traditional mode of delivery of science instruction. Data were collected using qualitative and quantitative techniques from 32 senior high school biology students, 15 of whom were girls, in two coeducational schools in Lagos, Nigeria. The results were in favor of the assertion that the combination of cooperative learning and concept mapping strategies was most potent in improving the problem-solving skills of students, especially the girls.

Oliveira, Maurícia

Session 8.07

Saturday, March 22, 1997
1:00pm-2:30pm
Regency A

Lab-Activities in Light of Critical Thinking

Belina T. Vieira

Research suggests that lab-activities, instead of being merely cook-recipes, may offer important opportunities for applying science processes, which are related to critical thinking abilities. This study was outlined (1) to find out whether Ennis' critical thinking working definition may be used as a theoretical organizer for developing lab-activities that infuse critical thinking into chemistry contents, and (2) to verify whether those activities influence and promote critical thinking level. A quasi-experimental design was adopted. The sample included 52 college students from a pre-service science teachers training course. During one semester, the control group performed the usual lab-activities from a curricular chemistry discipline. At the same time, the experimental group was submitted, to similar lab-activities but developed aiming to promote critical thinking skills. Pre and post scores on the Cornell Critical Thinking Test (Level X), were analysed for any significant gains. Only the experimental group reported significant gains. So, findings suggest that Ennis' critical thinking working definition may be a theoretical organizer for developing lab-activities fostering critical thinking abilities. The implications of the findings to science teaching and to pre-service science teachers are discussed.

Oliver, J. Steve

Session 3.11

Friday, March 21, 1997
7:00pm-8:30pm
York 1,2,3

How Teachers Change During an Institute: Quantitative Evaluation and Research Agenda

Denise K. Crockett Thomas Elliot David P. Butts

Middle school teachers attending three summer institutes were the subjects in a quantitative research study to examine the changes which they underwent as a result of workshop activities. In the original conception, the research was to cover 6 areas of teacher knowledge. These were: science content, process skills, laboratory skills, nature of science, curriculum, and attitude toward teaching. As a result of the first evaluative assessment, the teachers demonstrated a thorough knowledge of process and laboratory skills. Learning related to the nature of science was assessed using the Rubba and Anderson instrument as well as an instrument to assess knowledge of and ability to describe teaching activities which focused on "How We Know." Curriculum implementation was assessed using classroom observation, a teacher log, as well as daily plans created by the teachers. Changes exhibited by teachers in the affective domain were assessed using the STEBI (Science Teachers Efficacy and Beliefs Inventory, by Riggs and Enochs) and the CBAM (Concerns Based Adoption Model, by Hall). Science knowledge was assessed by having teachers identify relevant concepts and facts relative to topics covered in the workshop in a pre/post design.

Olkin, Arlene

Session 17.07

Monday, March 24, 1997
10:30am-12:00pm
Regency A

The Influence of Teachers' Attitudes on Their Adoption of Student-Centered Pedagogy

Project Alliance seeks to prepare teachers to gradually shift to more constructivist, student-centered classroom practice. Research suggests that attitudes engendered by long term participation in the culture of school and by personal experience, are resistant to change and exert powerful influences on teaching practice. A project goal is to address the nature of teachers' attitudes in order to effect substantive change in the way they envision and implement their roles in the educational process. The 60 teacher participants completed a three-part survey: (a) Attitudes about Reality Scale (AAR) (Unger, Draper & Pendergrass, 1986), (b) the ESTEEM Teaching Practices Assessment Inventory (Burry-Stock & Oxford, 1994), and (c) a personal information section. Analyses of survey responses, telephone interviews, focus group discussions with a subgroup of teachers, and classroom observations suggest that a majority of the teachers hold personal attitudes that are "positivist" or "eclectic," rather than "constructivist." While all teachers showed some level of adoption of student-centered teaching strategies attributable to project participation, "constructivist" teachers did so more readily and extensively than did "positivist" or "eclectic" teachers. Implications of these and other findings will be considered.

Olsen, Timothy P. **Session 9.04** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook II

Learning by Acting: Secondary Students' Environmental Project Work Mediated by a Geographic Information Systems Approach

Joseph Zaiman

A sociocultural perspective is adopted to narrate how a curricular context, formal schooling environment, a collection of spatial information tools, a current local environmental problem, real data, and teacher efforts to situate open-ended project activities on the periphery of an evolving technological community created opportunities for complexity, challenge, confusion, extended negotiation and some successes on the part of everyone involved. In the end, students presented arguments for an environmental restoration decision. Results tell the story of how 9th and 10th grade biology students were able to integrate data collection from the field with spatial information, carry out spatial queries and incorporate results into their presentations, but directing their actions and arguments to stakeholders beyond the science classroom did not take place for a host of social, historical and conceptual reasons.

Osisioma, Uzoamaka Irene Ngozi **Session 8.09** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency C

Remediation of Gender Inequity in Science in a Developing Country: An Experiment with Cooperative Concept-Mapping

The consistent reports on gender inequity in science achievement have led to a search for more effective strategies for correcting the imbalance. This study is part of this search which sought to investigate whether or not, the Cooperative: Concept-mapping technique will improve the science achievement of girls. A non-equivalent control group quasi-experimental design involving three intact groups was adopted. Three schools and three hundred and sixty-two (362) JSS II students in Nnewi urban, Anambra State of Nigeria constituted the sample. The subjects in each of the three groups were tested before and after treatment which spanned eight weeks. Test of Integrated Science Achievement (TISA) which had a reliability coefficient of internal consistency of 0.81 was used for data gathering. Results showed that the cooperative-concept mapping strategy improved significantly the achievement of girls in the selected integrated science concepts.

Palmer, Troy D. **Session 10.02** **Saturday, March 22, 1997**
4:00pm-5:30pm
Hunt 1,2,3

Evaluating an Earth Science Course for Prospective Elementary School Teachers

This study focused on teaching and learning issues in relation to an undergraduate earth science course for prospective elementary school teachers. The study employed an interpretive approach (Erickson, 1986) and a methodology consistent with Guba and Lincoln's (1989) responsive constructivist evaluation. Questions which served to initially focus the study included: (a) To what extent is co-participation and negotiated, shared discourse encouraged and developed in the classroom among students and instructors? and (b) To what extent is the instruction and learning grounded in real-world, semantically rich contexts that facilitate meaningful learning? Major data sources consisted of videotapes of class and lab sessions, observational field notes, interviews with instructors and students, and student questionnaire responses. Findings suggest that: (1) Lecture sessions were too didactic and traditional; (2) student interaction during lecture sessions did not achieve a desirable level; (3) use of computers and communication technologies in the lab component of the course was motivational and interesting to many students and appeared to foster good interaction between students and instructors; and (4) student assessment was generally very traditional in nature, and students expressed concerns with the assessments not matching the instruction received in lecture sessions.

Palmer, Troy D. **Session 7.06** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency A

High School Science Teachers Needs and the State-Wide Reform of Science Education in Florida

This study takes an interpretive look at the perceived needs of over 100 high school science teachers and highlights trends in the progress toward Florida's most recent efforts at educational reform. A belief that teachers perceive their extant practices and visions of what is possible through a frame shaped by their perceived needs serves as a rationale in the study for the foregrounding of teacher needs in relation to reform. Overall, the trends are not encouraging. Findings from both qualitative and statistical data suggest that, despite recent reform efforts, many critical needs of high school science teachers in Florida continue to go unmet. The push for reform that was to be energized by the 1989 release of Florida's *Comprehensive Plan* has apparently continued to be a top-down approach that has largely failed to involve teachers and other important stakeholders in any substantive efforts at the outset--both in the planning and implementation stages of reform. Since teachers' perceived needs serve as referents for their actions and practices, then it is imperative that such needs be acknowledged and dealt with in effective, meaningful ways if reform is to be successful.

Parke, Helen **Session 10.10** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency C

Examining Teacher-Student Interactions in Classroom Environments Using Story-Telling and Problem Solving in Authentic Contexts

This interpretive study investigates the six year journey of a middle grades science teacher, Mary, as she transforms her classroom practice from a technicist, transmittal context to one of reflective problem solving for supporting student understanding. An analysis of this journey of change as Mary reframes how she views teacher-student interactions can inform the design of staff development opportunities so as to understand more clearly the process of transforming practice and the tensions associated with it. Data collection included observation, interviewing, videotaping, audiotaping, and collection of artifacts. The analysis of the data looked for evidence of those events and conversations that impacted Mary's teaching, for tensions that arose while transforming her practice, and for those ideas and practices she identified as moving her forward in the transformational process. Are there pivotal events or conversations that occur with teachers to encourage shifts from transmittal patterns, common in K-16 classrooms, to social interactive patterns? Her shift was closely linked to a change in the teacher-student interactions in her classroom.

Parker, Dawn **Session 8.03** **Saturday, March 22, 1997**
1:00pm-2:30pm
Kent 1,2,3

A Description of Preservice Elementary Science Programs at Colleges and Universities in Texas

The intent of this study was to describe the existing state of the state with regard to the science preparation of elementary teachers at colleges and universities across the state of Texas. Information from a 50-item survey was analyzed from 61 Texas educational institutions in Texas involved in elementary teacher preparation. Data analysis focused on categories that represented various ways in which programs teach science and science pedagogy, collaborate among faculties of science and education provide essential field experiences, and prepare for professional development. Content analysis of survey responses showed that Texas elementary preparation programs were generally traditional in delivery of science content and pedagogical practice and that collaborative partnerships at educational institutions throughout the state were limited. Most institutions designed and implemented programs within departments, only communicating and cooperating with other departments or school districts when necessary to handle state guidelines and requirements. Opportunities for early field-based experiences were also limited. However, there were institutions across the state that recognized the importance of early field work and indicated a need for more information on how to implement this component. There were institutions that indicated professional development opportunities which generally included workshops, seminars, and mentor programs.

Parker, Dawn **Session 8.03** **Saturday, March 22, 1997**
1:00pm-2:30pm
Kent 1,2,3

Texas Poll of Elementary School Teachers

Debbie Jensen

The intent of this study was to represent the current practices and perspectives of elementary teachers regarding their teaching of science. This paper presents the design of a statewide telephone survey that was constructed to accurately describe the current science teaching practices in Texas public elementary schools and the extent to which these elementary teachers feel prepared for this task. This paper focuses particularly on the survey sampling procedures and questionnaire design for the poll that included 200 teachers from 40 Texas elementary schools randomly selected to participate in the poll. The sampling method was a probability proportionate to size (PPS) sampling design implemented to ensure that every elementary school teacher in Texas had an equal chance of being selected. The specification plan for questionnaire design followed the question-generating strategy established by the Annual Gallup Poll of Education. Accordingly, two- and four-year college and university faculty, public school curriculum specialists, educational service specialists, and master teachers were involved in the development of questionnaire items to accurately represent current science teaching practices and preparation of Texas elementary school teachers.

Parker, Lesley H. **Session 16.07** **Monday, March 24, 1997**
8:30am-10:00am
Regency D

Single-Sex Grouping as a Strategy for Constructing Gender-Sensitive Communities for Girls in Science

Léonie Rennie

This study was conducted in the context of the Single-Sex Education Pilot Project (SSEPP) which was implemented in 1993-94 in 10 coeducational schools high schools in Western Australia. The objective of the research was to study the interaction between gender-sensitivity and single-sex grouping in high school science/mathematics classrooms. Qualitative and quantitative data gathered during the project from teachers, students and classroom observations indicated that overall, single-sex grouping created environments in which teachers could implement gender-inclusive science instructional strategies more readily and effectively than in mixed-sex settings. In same-sex classrooms, the extent to which sexual harassment inhibited girls' learning was. of course, virtually eliminated. In addition, teachers were able to address some of the apparent shortcomings of students' previous education (specifically, the poor written and oral communication of boys and the limited experience of girls with "hands-on" activities and open-ended problem solving). The degree to which this occurred, however, was dependent upon teachers' prior commitment to the SSEPP project as a whole, and upon the support or obstacles encountered from a variety of sources, including parents, the community, students, and non-SSEPP teachers.

Parsons, Sharon **Session 12.04** **Sunday, March 23, 1997**
10:30am-12:00pm
Hunt 1,2,3

The Search for Routes to a Common Ground for the Building of a Community of Co-Learners

This paper reports on an on-going action research project which is attempting to establish a K-8 science education learning community. By assuming a postmodern perspective it examines the challenges involved in developing a collaborative relationship among student teachers, classroom teachers and university faculty. One research outcome is the recognition of the need to deal with the "scared stories" of university practice which contributes to power/knowledge relationships, and the master narratives in teacher education.

Pedretti, Erminia **Session 14.09** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency D

Technology, Text, and Talk: Students' Perspectives on Learning in a Technology Enhanced Secondary Science Classroom

Janice Woodrow **Jolie Mayer-Smith**

The purpose of this paper is to critically examine the teaching and learning impact of technology. The voices and multiple perspectives of students provide the focus for this study. The perceptions, attitudes, and responses of students involved in a long-term project of technology implementation called Technology Enhanced Secondary Science Instruction (TESSI) are explored. Specifically, the paper examines the technological and pedagogical impacts that emerge from the interplay between the implemented technologies and the cultural milieu of the classroom. The most striking finding of this study is that students focused on, and spoke more about issues pertaining to learning, than about technology or science. We consider this finding to be significant, and indicative that the pedagogical and cultural milieu of the TESSI classroom is every bit as influential as the technology itself. Students had well defined views about the value and uses of technology, and strong emerging perspectives on learning which included principles of independence, responsibility and freedom.

Pedro, Herminia **Session 9.12** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency D

Conceptual Change: A Study of the Concept of Photosynthesis in Pre-Service Teachers

The purpose of this study was to determine how students entering a School of Education understood the process of photosynthesis, how their understanding was influenced by previous biology courses, and how their understanding changed as a result of instruction in the science methods course. The 105 students in the experimental group received instructional materials focused on photosynthesis. These subjects and a control group were administered pre and post cognitive tests and prepared pre and post concept maps. A five category written test analysis was used to score the cognitive test with the concept maps analyzed using the methods of Novak et al. Although the materials that were used focused on activities and understanding, the students continued to memorize facts and terminology. Most students gave definitions of photosynthesis and food which were quite different from those generally accepted by biologists. The course instruction did improve student's conceptual understanding but alternative conceptions (misconceptions) persisted for many students.

Peterson, Raymond F. **Session 12.04** **Sunday, March 23, 1997**
10:30am-12:00pm
Hunt 1,2,3

A Problem-based Approach for Preservice Science Teacher Education

David F. Treagust

This paper describes a model based on problem-based learning (PBL) which was applied to a science teacher education program. The framework for the PBL program was designed using both the knowledge base for teaching and pedagogical reasoning. The knowledge base for teaching considered four components, namely science content knowledge, curriculum knowledge, knowledge of learners and pedagogical content knowledge. The pedagogical reasoning framework included six stages which were comprehension, transformation, teaching, evaluation reflection and new comprehension. Three problem-based scenarios were designed using this framework. Twenty one preservice teachers trialled the PBL program as part of the two semester second-year Bachelor of Teaching (Elementary) course. A case study methodology was used to evaluate the program. Results indicated that the program enabled the preservice teachers to develop both their knowledge base and pedagogical reasoning ability, and to become more self-directed and motivated learners.

Peterson, Rita **Session 7.11** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency F

Visual Memory and Language: Children's Use of Art and Language to Communicate Knowledge of Science

To address the 1997 NARST theme, Making a Difference: Building a Coherent Theory of Learning, this paper describes two related but different systems of cognitive processing: the relationships between visual learning and memory, and verbal learning and memory. Two experiments were conducted to understand natural variations in children's use of visual thinking and language to acquire and communicate knowledge about science. Experiment 1 evaluated the effectiveness of presenting a visual option (looking at pictures/drawing) with a standard language option (reading/writing) as a means of enhancing learning for students who have difficulty using primary language to successfully complete science assignments. Experiment 2 compared students' capacities to use both visual memory and verbal memory to demonstrate their knowledge of topics in science. The results of both experiments demonstrate that the addition of visual options for communication of knowledge about science is especially beneficial for language-challenged students but can benefit all students. The findings also suggest that a coherent theory of learning which relies on verbal knowledge and fails to acknowledge visual memory, in fact, provides a distorted view of students' knowledge of science, given the range of natural variations in students' capacities for visual and verbal learning and memory.

Philhower, Ramona **Session 7.02** **Saturday, March 22, 1997**
12:00pm-1:00pm
Kent 1,2,3

Design for Student Success: A Collaborative Effort in a Non-Science Major Biology Course

Robert Ketcham

Revision of a large introductory biology laboratory course by a collaborative team was begun summer of 1995. The revision blends innovative investigative laboratory experiences with a support system for the laboratory instructors. Long term investigations and short term student designed experiments are the core of this course. This paper will discuss how student feedback is used to evaluate the effectiveness of the course, and to refine the choice of investigations include in this course. The structure and use of the support system for the laboratory instructors will be described, also.

Polman, Joseph **Session 17.06** **Monday, March 24, 1997**
10:30am-12:00pm
Oak Brook III

Scaffolding Science Inquiry through Transformative Communication

Roy D. Pea

Teachers interested in fostering science learning through inquiry or projects must play a complex role in discourse with students. They must guide student activities in the classroom without taking away students' active role, like a coach. In this paper, we provide a framework for a specific form of scaffolding open-ended science inquiry, based on Pea's (1994) notion of transformative communication. We articulate how teachers in project-based science classrooms can appropriate students' moves in the research process and show them how to transform them into more sophisticated moves, thereby helping students learn. We provide specific case studies from interpretive research in a project-based high school earth science class. In one case, the teacher helps students transform information gathered from library research into seeds for a verification study. In a second case, the teacher helps students transform questions that seek established facts as answers into questions that frame research taking sides in a scientific debate. In a third case, the teacher helps students transform an unsupported claim and separate graphs into a graphical representation directly testing the claim. The strategy of transformative communication proves to be a powerful means of supporting students.

Powell, Janet Carlson **Session 10.11** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency D

KGS and the National Science Education Standards

The focus of this component of the KGS research agenda was to look at the alignment of the curriculum and the National Science Education Standards (NSES) and then to see how well students and teachers attain the identified standards. First we determined which of the content, teaching, and assessment standards were addressed by the KGS curriculum. We compiled this information in a chart indicating the standard, the fundamental understanding, the type of activity in the curriculum, and a page number for reference. Based on this alignment, we developed an assessment instrument for students to take before they began the KGS project and again after they finished the project. This assessment only measures how well students attained the content standards addressed by KGS. To score the pre and post tests we developed a rubric based on the KGS curriculum to determine how well the students demonstrated what they learned. We analyzed the pre and post test scores by calculating the descriptive statistics for the total scores, as well as running a paired t-test for the total scores and the score for each question. Of the ten items we analyzed (total score and 9 individual questions) there were three items with significant differences between pre and post-test scores.

Powell, Kathryn **Session 16.01** **Monday, March 24, 1997**
8:30am-10:00am
Hunt 1,2,3

Reprising our Science Training: Teachers' Perspective on Sense-Making in Professional Development

The purpose of this inquiry was to explore teachers perceptions of their personal sense-making as they participated in a three week biotechnology institute. Sense-making included the actions and processes used in integrating new knowledge into previous understandings. Ten participants were observed and interviewed formally and informally over a period of three weeks. The collected observations and interviews along with the institute materials were examined using inductive methods. Themes emerging from the data included a requirement for challenging material, connections to understanding and interactions with other professionals along with various *ways* to make sense. Teachers' descriptions of their ways of sense-making revealed very traditional patterns of note-taking, hands-on activities and questioning. Sense-making in the context of a biotechnology summer institute appears to reflect accepted practices of the classroom.

Priebe, Roger **Session 3.04** **Friday, March 21, 1997**
7:00pm-8:30pm
Cermak

The Effects of Cooperative Learning in a Second Semester University Computer Science Course

This study compared the content comprehension and logical reasoning ability in two groups of second semester university college students. The control group (n=30) received instruction in a traditional lecture environment three days a week for nine weeks. The treatment group (n=29) met in a cooperative learning environment (as defined by Johnson and Johnson) the same number of hours as the control group. Content comprehension was measured with the Burton Comprehension Instrument. Logical reasoning ability was measured with the Propositional Logic Test (PLT). The pre and post test results of each instrument were analyzed for significant difference between the lecture and cooperative learning groups. Preliminary results support many previous findings of increased performance in cooperative learning environments.

Priestley, Holly and William J. **Session 12.05** **Sunday, March 23, 1997**
10:30am-12:00pm
Kent 1,2,3

Exploring the Impact of Longer-term Intervention on Reforming Science Teachers' Approaches to Science Instruction

Teachers of life and physical sciences at the high school level experienced modeled lower-level inquiry-oriented instruction emphasizing shorter pre-laboratory sessions in which limited lecturing and no definition of terms was included, as well as longer post-laboratory activities that emphasized the use of student data and observations to drive further instruction. The experience resulted in significant changes in their course organization and teaching strategies used in the pre- and post-sessions. This result produced the following recommendations: (1) pre- and in-service science teachers must experience the reformed approaches to instruction that they are expected to practice; (2) they need ample opportunity to experience appropriate pedagogical practices within the context of science content in which they have the greatest strength. This experience is especially critical for life science teachers because they conduct post-laboratory sessions that are less than half the length of those conducted by the physical science teachers. (3) in addition, inservice courses should be designed to involve school administrators in the modeled instruction so that they can better understand why and how to be more proactive in supporting laboratory instruction. This proactive support needs to include school schedules that places laboratory experiences in priority over assemblies and other non-academic activities.

Puttick, Gillian M. **Session 8.05** **Saturday, March 22, 1997**
1:00pm-2:30pm
Harger

"How Much Light Does a Plant Need?" Questions, Data and Theories in a Second-Grade Classroom

The goal of this symposium is for presenters and audience to engage in a critical discussion of issues related to scientific inquiry, and specifically to experimentation, in elementary classrooms. Presenters are educational researchers, all with training in various scientific disciplines, with strong backgrounds in science education. The discussion will center around a video case study detailing one teacher's practice in his second grade science class as his students learn about experimentation. Presenters and audience will jointly analyze the videotape and accompanying transcript, focusing on such issues as what and how students learn, the various roles teachers and students assume, and how students and teachers engage in scientific discourse.

Rader, Cyndi **Session 8.11** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency E

Of Models, Meanings, and Misconceptions

Catherine Brand **Page Pulver**

A primary purpose of conceptual models is to facilitate students' construction of meaning. It is therefore important to understand how students create meaning from models. Our specific goals in this study are to determine how closely the meaning students extract from a model matches our intended content, what unintended meanings (i.e., misconceptions) arise from interaction with the model, and whether the use of abstract versus concrete representations has any effect on students' ability to construct meaning. We report the results of a study of 27 fourth- and fifth-grade students working with two models, a concrete "flies" model that was introduced as part of a classroom discussion and an abstract "gas" model that was initially used as a hands-on activity. Our findings suggest that children can extract key points from both abstract and concrete models, although the abstract model is more challenging in some respects. We also found some common sources of misconceptions that should be considered when creating and/or using conceptual models.

Rennie, Léonie J. **Session 3.03** **Friday, March 21, 1997**
7:00pm-8:30pm
Windsor

The Relationship between Attitudes and Classrooms Variables in Single-sex and Mixed-sex Science Classes

Lesley H. Parker

This research examines the relationship between students' attitudes about science and their perceptions of their science classrooms, with particular reference to (i) comparisons between boys and girls, and (ii) comparisons between single-sex and mixed-sex science classrooms. Over 700 students in five secondary schools responded to a multidimensional attitude questionnaire and gave their views of the nature of their participation and interaction in their science classrooms. The results indicate that considerable variance in students' attitudes and perceptions about science is associated with a number of classroom variables, particularly attentiveness and participation in class activities. These patterns of relationships vary for boys and girls according to whether the class has a single-sex or mixed-sex structure.

Reyes-Herrera, Lilia **Session 3.02** **Friday, March 21, 1997**
7:00pm-8:30pm
Butterfield

An Interpretive Study of Social Forces that Constrain Actions and Interactions in a Science Classroom in Colombia

The purpose of this research was to explore teaching and learning environments in a sixth grade science classroom and to analyze how teacher and students' actions and interactions were constrained by social forces associated with the large community. Guba and Lincoln's (1989) ethnographic research methodology was employed in the study. Sources of data were transcripts of videotaped classes, informal interviews, field notes and memoranda. Power and objectivism were identified as myths that limited the extent to which democratic practices were employed by the science teacher. An imbalance of power was evident in teacher's and students' actions and interactions. Power was apparent in issues of control, autonomy and equity. Evidence of teaching and learning within an objectivist framework was illustrated and interpreted with the following indicators: truth as referent; context free learning; and individual constructions of learning. If teachers identify referents for their actions and interactions and social forces constraining their practices they can critically reflect on them and improve their students'learning.

Rice, Diana **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Children's Trade Books: Do They Affect the Development of Science Concepts

Christy Snipes

For a number of reasons, the use of children's trade books in teaching science has recently been increasing. Very little research has been done in science education to determine how this practice affects children's understanding of science concepts. The objectives of this study were to determine whether listening to trade books would alter children's concepts and to characterize any altered concepts as more or less accurate or valid than the children's original ideas. Two second grade classes, a total of 42 students, participated in the study. Five trade books about a popular topic, whales, were read to the classes. For each book a five-six question test was developed and administered before and after the book was read to the class. For a large number of the questions, changes in answers were observed, approximately equal numbers from correct to incorrect as from incorrect to correct. Changes in answers tended to parallel the quality of information in the books. If information in the book relative to a question was correct, changes to correct answers resulted; if information was incorrect, many children changed to incorrect responses on post tests. Implications for science teaching, particularly in elementary grades, and suggestions for future research are discussed.

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Richmond, Gail **Session 13.06** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook II

How Students in a Scientific Apprenticeship Program Use Multiple Communities as Resources for Conceptual Growth

Lori A. Kurth

The purpose of this study was to investigate changes in students' perceptions about scientific process and practitioners (scientists) and the possible explanations for the shape these changes took as the students participated in a university-based summer research program. Twenty-seven high school students from across the US were interviewed individually three times during the seven-week period. Speech and nonspeech acts and text from the interviews, entry and exit questionnaires, journal entries, and videotapes of group meetings, were analyzed for what they revealed about students' notions of science and scientists, as well as the existence of communities in which they were participants. Three distinct cultural communities were identified within the structure of the program--laboratory-centered, program-centered, and peer-centered. Most students initially had fairly naive views of both the process and practitioners of science. Their ability to use the different resources located within each of these communities, as well as their ability to articulate the importance of these resources greatly influenced the extent to which their perceptions became more complex over time.

Rickards, Tony W. **Session 8.09** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency C

Teacher-Student Interpersonal Behaviour, Cultural Background and Gender in Science Classes

Darrell L. Fisher **Barry J. Fraser**

The purpose of this study was to determine associations between science students' perceptions of their teachers' interpersonal behaviour, some factors of the students' gender and cultural backgrounds and their attitudinal and achievement outcomes. A sample of 3048 students from 133 secondary school science classes in 25 schools completed a survey including the Questionnaire on Teacher Interaction (QTI), an attitude to class scale and questions relating to cultural background. The sample was chosen carefully so as to be representative. Achievement on internal school benchmark assessment tests were used as student outcome measures. Statistical analyses confirmed the reliability and validity of the QTI for secondary school science students. Furthermore, it was found that student perceptions of teacher-student interpersonal behaviour were related to their achievement and there were differences in the perceptions of students from different cultural backgrounds.

Riley, Joseph P., II **Session 4.01** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Framework for a Japan/United States Collaborative Research Project on Science Teacher Education

Michael J. Padilla **Hideo Ikeda**

Japanese students have consistently scored high on international science assessments. While home factors have often been cited as the chief reason, little information is available regarding Japanese science teacher education and the role it plays in student achievement. Such information could inform U.S. national efforts in reforming science teacher education to meet recently released national science standards. This paper describes the planning framework for a collaborative research effort between the University of Georgia and Hiroshima University to investigate the recruitment, education and professional development of science teachers in Japan and the United States. Findings on preservice science teaching field experiences and induction practices will be presented.

Roberson, Jeanie **Session 9.01** **Saturday, March 22, 1997**
2:45pm-3:45pm
Hunt 1,2,3

Mentoring the Beginning Science Teacher: Interpersonal Influences on Learning to Teach

Margaret W. Smithey **Carolyn M. Evertson**

The purpose of this research was to add to the knowledge about the process of learning to teach that occurs under the guidance of a mentor science teacher. The guiding question for this qualitative study was, "What are the critical elements in a mentoring relationship in which an experienced science teacher helps a beginning science teacher learn to teach?" To answer this question a mentor/protégé pair was observed four days a week for one semester. The data analyzed included field notes from observations, transcripts from video and audio tapes of interviews and observations, a dialog journal kept by the protégé and mentor, a reflective journal kept by the protégé, lesson plans and other protégé-generated class materials. This paper tells the story of a mentoring relationship that began strong but within a short time began to disintegrate. Analysis of the data revealed five components that were missing from this relationship that seemed to derail the chances for effective mentoring: Clear and realistic expectations; humility; willingness to listen and learn; empathy; and open and constant communication.

Roberts, Douglas A. **Session 10.08** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency A

The School Science Curriculum: Many Choices for Policy Makers, Many Meanings for Students

Glen S. Aikenhead **Arthur N. Geddis** **Graham Orpwood** **Leif Ostman**
Brent Kilbourn

This symposium is about different kinds of meaning that can be present in a school science curriculum, how they get there, and how they are communicated to students. A key concept is 'companion meanings,' so named to capture the point that they accompany students' learning the scientific meaning of concepts, theories, etc. Currently popular sources of systematic companion meanings for science programs include STS, history and philosophy of science, and constructivism. Alas, these are often advocated in the research and professional literature as if their value is both self- evident and universal, rather than being presented as possibilities for curriculum policy makers to consider in their unique situations. Less systematic and often undesirable companion meanings can be overlooked because they are usually communicated implicitly. The authors present theoretical perspectives intended to revitalize debate about the substance of science curriculum by considering these various aspects of meaning.

Robinson, Cecil D. **Session 8.11** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency E

Static No More! Students beliefs About Models and Science

The Science Theater/Teatro de Ciencias (sTc) project is a model-based technology-supported curriculum that allows elementary school children to create and manipulate models as a means inquire about how and why things happen in a concrete, manipulable form. The purpose of this study is to examine how this curriculum affected student beliefs about models and science. Twenty-five fourth and fifth grade students were interviewed about their beliefs of models and science prior to instruction. After building two science-related models, the students were interviewed a second time. The second interviews varied slightly from the first interview, including specific questions about the utility of models and their relationship to science. Transcripts were independently coded by two researchers. Results indicate nearly all students are beginning to extend their understanding of science as a static body of facts and independent skills to a dynamic process of inquiry. Further, over half the students extended their initial belief that models are just smaller versions of real-world phenomena to include models as a means to show or learn about real-world phenomena.

Robinson, Janet B. **Session 8.13** **Saturday, March 22, 1997**
1:00pm-2:30pm
York 1,2,3

Voices of Reform: The Administrator's Faint Voice, but Vital Role

School district administrators and their roles appear to be a missing link in many science education reform efforts. This study was undertaken to determine the knowledge, beliefs, and attitudes of administrators of districts involved in a major science education reform project in a midwestern state. Survey instruments were mailed in the spring of 1995 and 1996 to school district principals, superintendents, and curriculum coordinators. Follow-up interviews were conducted in May of the same years. Survey and interview data served to validate each other. The average school administrator may not believe they should play a vital role in the reform of science education, or indeed, may not even believe that any type of reform is needed. These perceptions are changing among project school administrators. The findings shared will have implications for developing effective procedures in future science education reform efforts, as well as documenting the voices and growth among the administrators of the project schools.

Rodriguez, Alberto J. **Session 3.03** **Friday, March 21, 1997**
7:00pm-8:30pm
Windsor

Strategies for counter-resistance: Helping preservice teachers teach science for understanding and for social justice

This paper reports on two types of preservice science teachers' resistance: Resistance to ideological change and resistance to pedagogical change. The former has to do with the feelings of disbelief, defensiveness, guilt and shame Anglo-European preservice teachers experience when they are asked to confront racism and other oppressive social norms during class discussions. Resistance to pedagogical change has to do with the "roles" preservice teachers feel they need to play in order to manage the conflicting messages they get from what they are expected to do by their cooperating teachers (cover the curriculum, maintain class control), and by what they are expected to do by their university supervisors (implement student-centered, constructivist class activities). Although these two forms of resistance are closely linked, they are extensively reported separately in three related bodies of literature: multicultural teacher education, teacher socialization and learning to teach. This study merges information from these areas of inquiry and reports on specific pedagogical strategies for counter-resistance found to be effective in helping preservice teachers learn to teach for diversity and for understanding. These strategies for counter-resistance were primarily drawn from the qualitative analysis of a year-long project with secondary science preservice teachers.

Rogers, Laura N. **Session 6.06** **Saturday, March 22, 1997**
10:30am-12:00pm
Hunt 1,2,3

Motivation to Teach as a Factor in the Professional Development of Preservice Science Teachers

Sarah Bond **Joanne Nottingham**

The purpose of this study was to examine motivation to teach as it influences the professional development of preservice secondary science teachers and the decision to pursue a teaching position after completion of licensure requirements. Preservice teachers were interviewed formally and informally; the results of those interviews were transcribed by the researchers. Other data sources included field notes made during classroom observations, journal reflections, preservice teacher-prepared materials (handouts, tests, worksheets, lesson plans, etc.), and written responses to surveys and questionnaires. The preservice teachers in this study consistently provided a lower assessment of their teaching than was reported by the course instructors. As full-time teaching experiences began (during student teaching), confidence rose and self-assessments became more specific but remained somewhat lower than instructors' assessments. Those preservice teachers who reported intrinsic motivation for teaching provided more reflective and detailed analyses of teaching strengths and weaknesses than did their extrinsically motivated peers. A distinction in reflective responses between intrinsically-motivated and extrinsically-motivated preservice teachers was observed and could provide a powerful tool in focusing efforts to enhance professional development.

Rogg, Steven R. **Session 14.06** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency A

Conducting a Standards-Based Inventory of Middle-Level Science Curricular Materials

Jane Butler Kahle

The purpose of the standards-based inventory is to reveal the degree to which extant middle-level science curriculum materials represent the text of the National Science Education Standards (NSES). The study was designed to be descriptive in nature; that is, evaluation of these materials with respect to interpretation of the intent of the NSES is avoided. Instead, the inventory provides: (1) characterization of the distinguishing properties of individual products as revealed by text within the product in alignment with specific NSES organizing concepts; (2) comparative analysis of products to test how combinations of them might be assembled as a curriculum to more fully represent the NSES; and (3) development of an overall profile of the state of the current middle-level science curriculum portfolio as suggested through an NSES perspective. The inventory process involved more than 40 collaborating science educators who identified text quotations aligned with specific NSES organizing concepts from within more than 60 curriculum products. Assessment of the consistency of these expert judge ratings and of the overall validity of the citation process is reported. Results of the inventory confirm the viability of this approach for characterizing materials and for revealing both deficiencies and redundancies in the portfolio.

Roth, Wolff-Michael **Session 8.08** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency B

Cognition during 'Hands-on' Physics: Toward a Theory of Knowing and Learning in Real Time.

Reinders Duit **Michael Komorek** **Jens Wilbers**

We developed a framework for studying and theorizing students' knowing and learning in real time as they engage in school physics activities. This framework takes agents interacting with their settings as the unit of analysis. Settings and all objects and events therein are taken to be ontologically ambiguous and therefore interpretively flexible. Agents' activities, goals, and learning are characterized by their emergent nature and are not specifiable a priori. Language, perception, material practices, and the world of experience co-evolve and mutually constitute each other through interactive stabilization. Learning can be shown at the level of individuals, groups, and classroom communities by analyzing changing discursive and material practices. Two case studies of knowing and learning, based on data collected during an innovative curriculum on chaotic systems, are used to illustrate the framework. The framework has considerable implications for the use of 'hands-on' science activities intended for the construction of canonical scientific knowledge.

Roychoudhury, Anita **Session 6.10** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook IV

Concept Development through Inquiry-Based Projects and Related Reflections

This study analyzed the development and/or changes in preservice elementary teachers' thinking about weather-related concepts as they engaged in inquiry-based projects. Students enrolled in a physical science course collected weather-related data and attempted to identify the relationships among the variables. During the project, they received guiding feedback from the instructor. Their reflections about the project, individual learning, and their views about the utility of such open-ended projects were also analyzed. Students considered the pedagogy of the projects to be useful, albeit frustrating at times. They also illustrated a strong preference for more structure to their projects and a distorted view of scientists' work.

Rua, Melissa **Session 13.03** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Students' and Teachers' Mental Models of Germs and Illness

Gail Jones

The purpose of this study was to investigate and compare the conceptual understandings, or mental models held by students and teachers about the knowledge domain related to germs and illness. Sixty students in grades 5, 8, and 11 as well as 12 teachers participated in the study. Both students and teachers performed a card sorting activity, made graphical representations of germs and participated in a 20-30 minute interview. Multidimensional scaling techniques were used to determine how frequently a participant placed each of the twenty concept cards with another concept. The drawings were analyzed by noting common traits and by developing categories for of emerging commonalities. Transcripts provided insight into the analogies and metaphors used by the participants as well as the identification of 11 categories and 7 subcategories of common beliefs. Results indicate that there is a distinct developmental component to the beliefs and misconceptions held by the participants and that the participants were able to refer back to specific prior experiences that influenced their conceptual understanding of germs.

Rye, James A. **Session 6.10** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook IV

Student's Perceptions of the Interview as a Means to tell What They Know

The interview is widely accepted as a research tool to externalize students' understandings. Interview-based research must recognize a critical problem: the interviewer's ability to externalize those understandings. The purpose of this study was to investigate students' perceptions of an interview as a means to elicit their post-instructional understandings of cholorofluorocarbons (CFCs). Participants were 38 students from an eighth grade physical science course, who were assigned randomly to complete a concept interview that embedded a concept mapping process (POSTIMCI) or one that did not embed that process (POSTICCI). Each interview was guided by a standardized open-ended protocol that began with an initial quiet time for the student to "think about" CFCs. The majority of students completing each type of interview (POSTICCI, 82%; POSTIMCI, 59%) believed that the quiet time helped them to think and talk about CFCs. Only 24% indicated that the reflective responses issued by the interviewer and revisiting each interview question were helpful. Over 75% of students completing the POSTIMCI believed that the concept mapping was helpful and the majority believed this affected positively their recall of knowledge about CFCs.

Salmi, Hannu **Session 14.03** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook I

A Quasi-Experimental Study of Science Learning and Motivation in Informal Science Settings

The purpose of this study was to advance earlier findings which suggested a link between the intrinsic motivation and deep learning strategy in informal settings. The subjects (N=75) of this study visited a science centre exhibition once a month during the school year according a plan fitted to the science curriculum of the school class and the exhibitions of Heureka Science Centre, Vantaa, Finland. The development of motivation, thinking abilities and self-concept was measured before and after the visits, and repeated measures analysis was used to analyse the data. The results of these standard tests also were compared between the gifted pupils in the research group and average school groups. The results showed that the intrinsic motivation increased in all the groups during the period. Some development in reasoning abilities was also found. Well-talented pupils seemed to make most progress during the project. No statistically significant gender differences were found. The results indicate that informal learning settings do diminish instrumental motivation and can make it possible to increase the use of deep learning strategies.

Sandifer, Cody **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Examining Connections Between Time-Based Behaviors at a Science Museum: The Emergence of the Interested Visitor

The primary purpose of this study was to compare interested and noninterested visitors across a series of time-based behaviors (e.g., fraction of time engaged with exhibits). Forty-seven visitors were tracked through two interactive, thematic exhibitions at the Reuben Fleet Science Center. An interest statistic was introduced: (the number of exhibits with which a visitor spent at least 2 minutes) divided by (the number of exhibits with which a visitor became engaged). Visitors who attained an interest statistic of .33 in an exhibition were classified as interested in that exhibition. It was found that interested visitors (14 total) spent more time in their exhibition of interest and were engaged with exhibits a larger fraction of the time than their noninterested counterparts. A secondary goal was to determine if visitors' total time in the science center and time per exhibit were affected by the day of the visit (weekend/weekday) and type of visitor group (family/nonfamily). In a 2 x 2 ANOVA analysis of total time, the day main effect was significant; in a similar analysis of time per exhibit, there was a significant day by group-type interaction. The implications of these results are discussed.

Sandomir, Mark **Session 13.06** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook II

Challenging Prevailing Assumptions About the Use of Metaphoric Statements in the Acquisition of Science Conceptions

Robert J. Stahl

This paper establishes a context for the use of metaphors within learning situations and describes a constructivist operational model for determining metaphoric comprehension aligned with scientific content and concepts. Students enrolled in college preparatory chemistry completed (a) a pretest, immediate posttest and delayed post-'Free-Recall' Content Test and (b) a test of metaphoric comprehension constructed from specific metaphoric expressions aligned with atomic structure and the Bohr and quantum mechanical theories (e.g., The atom is a solar system). Very few pre-, post- and delayed-posttest score differences were revealed either in the kinds of information students used to describe specific metaphoric expressions or in the meaning students attached to these expressions. Students consistently attributed high meaning to atomic structure-based metaphoric statements grounded in very little accurate information. There is *no* evidence that using metaphoric statements that refer to properties of atomic structure has the immediate, in-depth, accurate, and far-reaching consequences that advocates of the use of these particular metaphoric statements or of metaphoric statements in general claim. Quantitative and qualitative data reveal that current assumptions and assertions about the impact of metaphors to aid content learning and accurate conceptions of phenomena are inappropriate and appear themselves to be misconceptions about metaphoric language.

Saranchuk, Ron **Session 13.01** **Sunday, March 23, 1997**
2:30pm-3:30pm
Butterfield

Connected Learning in a Competency-Based Curriculum

This naturalistic case study examined how dimensions of student learning compared according to the instruction and assessment experienced in early and advanced competency-based health science classrooms. A multiple and critical-case sample of four teachers and thirty-two students in four third-year science classes in a chiropractic college were interviewed and observed. Marzano's (1992) dimensions of connected learning were used as the basis for this inquiry. Data was analyzed according to form of teacher instruction and assessment, and nature of student learning. Students in the advanced competency-based setting demonstrated a more developed ability to transfer their classroom knowledge to their clinical settings compared to those in the early competency-based classrooms. In addition, while students' thought processes in the 'early' classrooms were convergent, those in the more 'advanced' were relatively divergent. This study implies that modifications to the organization and delivery of knowledge may provide health science students with more opportunities to apply and transfer their classroom knowledge to their clinical settings.

Saturnelli, Annette Miele **Session 17.10** **Monday, March 24, 1997**
10:30am-12:00pm
Regency D

District-wide Implementation of Gender and Cultural Sensitivity in the Science Classroom: A Supervisor's Perspective

This paper describes the logistics of implementing gender and cultural sensitivity awareness to all the science teachers in a school district, which reflects the demographics of the year 2000 i.e. 51% minority students. Over a period of two years teachers participated in two staff development courses for elementary and middle -level district teachers. The training was based on the underlying assumptions that every child can learn and is capable of learning, if provided with the right teaching and learning environment and that change in classroom practice must involve teachers as instigators and participants in the change process. As teachers graduated from the training they became teacher mentors and were responsible for implementing changes in their school. Some of them were subsequently selected to become teacher leaders in the training in subsequent years.. Anecdotal reports from 24 teachers are presented along with statistical analysis of the performance of 2500 students who were taught by these teachers during a 2 year period. Student results indicate significant gains in interest and achievement in science by all students particularly female and minority students.

Scantlebury, Kathryn **Session 7.02** **Saturday, March 22, 1997**
12:00pm-1:00pm
Kent 1,2,3

The Three R's of Cross-Institutional Collaborations: Reform, Responsibility and Respect

This paper will discuss the efforts of a K-16 science education community to begin the challenge of reforming K- 16 large undergraduate science courses for non-science majors across several institutions. Our K-16 Community Partnership comprised of university and community college faculty and K - 12 inservice teachers. At the crux of our reform efforts is the mutual respect for each person's strengths and weaknesses in our K-16 Community Partnership and the recognition that most of our group are stakeholders and border crossers in this enterprise. The second and third papers in this set will give discuss two large enrollment science courses for non-science majors.

Scantlebury, Kathryn **Session 6.03** **Saturday, March 22, 1997**
10:30am-12:00pm
Spring Room

Enhancing Equity in Science Teaching: A Collaborative Effort

Bambi Bailey

Cooperating teachers are prominent people in influencing the next generation of teachers because they interact daily with student teachers. This paper discusses the impact of cooperating teachers on student teachers' teaching strategies, questioning patterns and interactions during their teaching practicum. University science educators collaborated with cooperating teachers to develop observational tools for observing student teachers during their practicum. University science educators and the cooperating teachers used the tools to collect data and discuss the results with the student teachers. During the first year of the project, student teachers working with the project teachers were more equitable in their questioning patterns and more likely to ask all students higher-order questions than their peers. Data from the second year showed an overall increase in the number of higher-order questions asked by all student teachers.

Schaller, John S. **Session 9.05** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook III

Establishing Credibility and Authenticity in Ethnographic Studies

Kenneth Tobin

In the past decade there has been increasing acceptance of ethnographic approaches to research but much of the criteria for judging the quality of this work has continued to be objectivist oriented. Such research texts fall short of communicating the intricacies of the classroom experience in a credible and compelling manner because of this lack of quality criteria in the research methodology as well as the limitations of technical writing styles. Four vignettes that are examples of different genres of interpretive research were chosen in this paper to illustrate an evolving relationship between the methods used and the substantive research issues in science and mathematics education, and are: teaching and learning science; student stories; critical autobiography; and fictive stories. For an interpretive study to be authentic, we have found it is necessary for the researcher to employ six procedures that are employed to satisfy issues of credibility. They are prolonged engagement, persistent observation, peer debriefing, negative case analysis, progressive subjectivity, and member checks. In addition, a progressively more challenging rhetorical heightening of the narrative is depicted as the vignettes progress from participant observation to critical autobiography to the literal creation of virtual texts through the use of fictive methods.

Scharmann, Lawrence C. **Session 13.03** **Sunday, March 23, 1997**
2:30pm-3:30pm
Harger

Cooperative Learning in Preservice Teacher Education: A Synthesis of Three Applications

Much research has been devoted in the recent past to the manner in which cooperative groups should be formed, the optimal number of learners per group, and the extent of accountability to which groups versus individuals should be respectively held. Prevailing wisdom in United States educational research circles has advocated that cooperative learning should be maximized in groups formed heterogeneously on the basis of achievement (aptitude), using 3-5 members per group, and with provisions for both individual and group accountability. In this paper, three applications (studies) will be described in which a criterion more specific than science achievement was used to form cooperative groups. The results of each study significantly demonstrate that cooperative learning success depends heavily on the nature of the learners engaged in each group's composition. In other words, rather than form groups by using exclusively prior course achievement, groups should be formed by matching learner characteristics and needs to intended target learning outcome(s). Implications and recommendations for future study will be included.

Schaverien, Lynette **Session 8.12** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency F

A Biological Basis for Generative Learning in Science

Mark Cosgrove

The modern history of biology shows how Darwin's selectionist theory has replaced instructionist theories in explaining the operations of living things: first, in the 1850's, with inheritance through the gene pool and second, in the 1960's, with the replacement of a template theory of immune system function. Now, scholars in several disciplines consider that the brain is a Darwin machine, too. Underpinning Darwinism is a generative heuristic, in which entities (or variants) are generated, and later subjected to tests. Entities which survive the testing are re-generated, and so on. This heuristic offers considerable value for science education. In this paper, it will be argued that both the nature of science and of its learning can be understood through the application of this heuristic.

Schletter, Jens Christoph

Session 9.11

Saturday, March 22, 1997
2:45pm-3:45pm
Regency C

Students' Conceptions of Learning and Memory

Horst Bayrhuber

Neurobiology is one of the areas in modern biology which is developing in a particularly lively way. In contrast, traditional school lessons deal rather inadequately with the findings of modern neurobiology. Additionally, only little is known about students' conceptions on this topic. The purpose of this study was to combine research on high school students' conceptions of learning and memory with the search for ways to take students' ideas into consideration when developing new teaching materials. Twenty students were interviewed about neurobiological and psychological aspects of the topic as well as on their learning experiences. Results show that students' ideas are primarily based on personal learning experiences and that neurobiological knowledge taught earlier in school is not integrated into these experiences. Based on the results of the interviews teaching materials for a unit on "learning and memory" were developed. In these materials, students' experiences are used as starting points in neurobiological and psychological inquiry of learning and memory. In a subsequent study, it will be investigated whether the new materials enhance integration of neurobiological, psychological and everyday knowledge in the heads of the students compared to traditional instruction.

Scholer, Anne-Marie

Session 10.06

Saturday, March 22, 1997
4:00pm-5:30pm
Oak Brook IV

Mentors and Menaces: Teachers and Graduate Advisors of Women Who Are Now Academic Biologists

This qualitative study is concerned with the teachers and graduate advisors of a group of women who are academic biologists. The participants in the interviews report both positive and negative interactions. These experiences include the traditional teaching of scientific techniques, and also the introduction to the scientific community. Teachers have also been reported to influence choices in field of research, and to demonstrate expectations for quality of work. Given that none of the advisors are female, as are few of the teachers, many of the younger participants are concerned with the scarcity of female role models, particularly with respect to balancing a personal life with a career in science. Future areas of interest include the impact of faculty preconceptions of ability on college and graduate student performance.

Schriver, Martha

Session 13.04

Sunday, March 23, 1997
2:30pm-3:30pm
Hunt 1,2,3

Change of Major Patterns between Females and Males in Science and Mathematics Education

Jay Strickland

This study compared the stated major of females and males in secondary science and mathematics education. Data collected covered cohort groups over a five years period of time. Changes of major was collected within each cohort group during the fall quarter of each year. Descriptive statistics were used to indicate patterns in change of major for both males and females. Results indicated different patterns for those changing major for females and males.

Segal, Gilda **Session 6.08** **Saturday, March 22, 1997**
10:30am-12:00pm
Oak Brook I

A Sociocultural Model of Learning and Teaching in Early Childhood Science Education

The purposes of this study were first, to investigate the process of development of young children's ideas when (and if) they appropriate science from the conceptual area, *light*, during whole class and small group interactions; and second, to advance understanding of relationships between a collaboratively designed learning and teaching model and children's developing scientific knowledge. This paper tells the story of children's learning in a Year 1/2 class. Children cooperated with their teacher's skilful modelling of how to conduct fruitful discussion. The high engagement of children in class discussions was revealed by their ever-lengthening and increasingly fluent contributions. Children expressed complex ideas; their classmates listened intently and interacted directly with the contributor, unmodulated by their teacher. The informal inquiry sessions, where children could investigate their own questions, or those generated in class discussion, stimulated further deep thinking about the learning model context and provided material for reflection on learning. Mediational means for development of children's thinking can be attributed to child, teacher and parental characteristics grounded in their middle class culture and values, in the design of the learning and teaching model and in the use children made of their personal learning journals.

Sessoms, Deidre B. **Session 3.03** **Friday, March 21, 1997**
7:00pm-8:30pm
Windsor

Undergraduate Minority Students Studying Science: Are You "Acting White" if You're Academically Successful ?

In this qualitative case study I describe and analyze the experiences of minority undergraduates studying biology at the University of California at Davis. Each of the students participated in an enrichment program, which functions as the unit of analysis for the study. Both interactive and non-interactive ethnographic methods were used, including interviews, questionnaires, and participant observation. Contrary to what might be expected based on recent research, these academically successful minority students do not see themselves as sell-outs, or 'acting White', even when some of their peers accuse them of just that. These students attribute much of their undergraduate academic success to the experiences they had working as research assistants in scientific laboratories on campus. I contend that they became "bi-cultural". Becoming part of a research lab provided these students with a scientific identity, while their participation in culturally and politically relevant activities supported their ethnic and racial identity.

Settlage, John **Session 10.07** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook IV

When Science Education Faculty Return to the Classroom: The Tale of Two City's Professors

Czerniak, Charlene

Having begun our science education careers as classroom teachers, we now find ourselves as college faculty preparing others to teach science. Our own teaching experiences were in suburban to rural school systems with a largely white and middle-class student population. Because of the urban locations of our respective universities, we found ourselves questioning our expertise when it came to preparing education majors for urban field experiences. Although our college students never questioned or contested our claims about what constitutes effective science teaching for urban children, we felt obligated to test the veracity of our belief systems. Each of us assumed the role of elementary classroom science teacher in public school classrooms. Lessons were videotaped and reflective journals were maintained during the experience. We describe what we discovered about our prior assumptions in light of our teaching attempts in urban classrooms. Findings will be presented related to participation patterns within class discussions, the impact of classroom traditions and cultural norms on instruction, and the nature of interpersonal relationships within cooperative learning groups.

Settlage, John **Session 9.09** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency A

Preservice Elementary Teachers' Self-Efficacy and the Relationships to Their Understanding of the Learning Cycle

Efforts to teach undergraduate elementary education majors about the learning cycle have been met with various levels of success. Despite extensive modeling by the course instructors and examining curricula that employ the instructional approach, understanding the learning cycle proves difficult for some students while is readily accepted by others. This study sought to investigate whether relationships existed among performance on a test of the learning cycle, science teaching outcome expectancy, and personal science teaching self efficacy measures. The Science Teaching Efficacy Beliefs Instrument (preservice teacher version) was administered at the start and conclusion of four sections of a science methods course (two instructors over two academic terms). Significant improvements on both subscales of the STEBI -B were found independent of the instructor for the course. Degree of understanding of the learning cycle could be predicted by pretest outcome expectancy scores but not personal science teaching self efficacy. Posttest measures for both efficacy subscales correlated significantly with learning cycle understanding. This suggests that training in the learning cycle has a positive influence on preservice teachers' belief in their ability to provide quality science instruction and that their efforts will result in desirable outcomes in terms of children's science learning.

Shapiro, Bonnie **Session 8.10** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency D

The Potential of Semiotic Interpretation of Learning Environments

This paper explores the potential of a semiotic interpretation of science learning environments. Semiotic studies assume that one's culture provides a set of signs, symbols and rules about interaction that are used to create and 'read' the learning environment. Semiotics therefore broadens the term 'learning environment' to include these signs, symbols and rule sets as powerful features that influence learning and teaching. The paper introduces semiotic interpretation of the science learning environment, including significant signs, symbols, semiotic formations and activity structures that must be grasped to access science knowledge. Features of architectural design and the arrangement of space, lesson organisation and structure, manifestations of the structure of power and authority, and routines of thinking, speaking and acting are considered. A major part of the paper involves illustration of the use of semiotics in science education research through the reporting of specific case studies. For example, certain rigid presentations of structures such as the scientific method become, for many teachers and students, the embodiment of science itself, creating an image of science as a prescriptive technique rather than a complex process of coming to know. Textbooks and bulletin boards which carry photographs of science being conducted only by representatives of one gender or race present a significant message of exclusion to learners.

Shaw, Edward L. **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Manipulatives in the Elementary Science Classroom

Mary Hatfield

The purpose of this study was to determine familiarity with availability of, and usage of 13 different science manipulatives in elementary classrooms. Data were collected on factors influencing manipulative usage and units often taught using manipulatives. The survey was administered to kindergarten through sixth grade teachers. Results indicated that 75% of the participants were familiar with ten out of the 13 manipulatives. Teachers indicated that they had access to 85% of the manipulatives. Overall use of science manipulatives by teachers with varying years of teaching experience did not indicate a difference. Results indicated factors that influence the use of manipulatives are availability of the manipulatives and noise level created by children while using the manipulative. Teachers identified magnetism and light units as requiring manipulatives for successful teaching to occur. The lack of manipulative use in the elementary schools is placing students at risk for becoming scientifically literate. To address problems identified in this study, a separate inservice program for administrators and teachers was indicated. Successful teachers, comfortable with using manipulatives, will provide a more conducive learning environment for students.

Shayer, Michael **Session 16.05** **Monday, March 24, 1997**
8:30am-10:00
Regency B

New Evidence of the Effect of CASE

Data is now available from about 900 students in 6 schools who completed the CASE intervention in grades 6 and 7, and from about 20 non-CASE schools. Piagetian Reasoning Tasks were given as pre-tests to all in September 1991, and students' scores on National Curriculum KS3 tests given at the end of Grade 10 (three years later) were collected. School mean KS3 grades are regressed on to the pre-test school means. The 'value-added' by the CASE schools is consistently about 25 percentile points higher than in the non-CASE schools. Data will also be presented on the corresponding GCSE grades obtained in June 1996, 3 years after the end of the intervention. The long-term far-transfer effects of the original CASE projects have been replicated on a larger scale, as part of an ongoing professional development program.

She, Hsiao-Ching **Session 8.09** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency C

Gender Difference in Teacher-Student Interaction in High and Low-Achieving Middle School Biology Classes

The purpose of this study was to investigate different gender students interaction with teacher in high and low-achieving middle school biology classes. A total of 46 and 44 students from high and low-achieving classes, respectively, were observed for heir interaction with teacher for a semester. Results showed that males received more teacher-initiated questions, teacher-directed interactions, and teacher feedback than females in both HAC and LAC; but the degree of gender differences in those interaction pattern are varied form high to low-achieving classes. On the other hand, males in HAC and LAC received more instances of every kinds of teacher feedback than females, but females in LAC received more instances of praise and further question from teacher. In addition, different gender students-initiated interaction with teachers also differed in HAC and LAC. Males in HAC initiated more questions than females, while females in LAC initiated more questions than males did.

She, Hsiao-Ching **Session 3.10** **Friday, March 21, 1997**
7:00pm-8:30pm
Ogden

The Development of a Questionnaire for Assessing Student Perception of Teacher Behaviors in Taiwan and Australia

Darrell L. Fisher

This paper reports part of a cross-national study of science classroom environments in Taiwan and Australia. Specifically, it focuses on the development and validation of a questionnaire to assess student perceptions of a central aspect of the classroom learning environment, namely, teacher behavior. In particular, the questionnaire assesses Higher-Order Questioning Behavior, Encouragement and Praise Behavior, Non-Verbal Supportive Behavior, Understanding and Friendly Behavior, and Strict Behavior. The development process included the translation of the English version into Chinese, the independent back translation of the Chinese version into English again by people not involved in the original translation, and subsequent changes to the wording where necessary. Further refinements were made based on interviews with students about their comprehension and interpretation of items. Administration of the questionnaire to 3,000 students in 100 grade 7–9 science classes in Taiwan and Australia supported each scale's internal consistency reliability and a priori factor structure.

Shepardson, Daniel P. **Session 14.05** **Sunday, March 23, 1997**
4:00pm-5:00pm
Oak Brook III

A Vygotskian Perspective on Learning Science

This paper presents a Vygotskian perspective on how children learn, providing one framework for understanding how children learn science. The paper synthesizes the essential aspects of Vygotsky's theoretical perspective: internalization, psychological and technical tools, concept development, everyday and scientific concepts, thought, and word meaning. Vignettes from a first-grade science lesson are used to illustrate Vygotsky's theoretical perspective on learning. Pedagogical implications are also explored.

Sherwood, Robert B. **Session 6.13** **Saturday, March 22, 1997**
10:30am-12:00pm
York 1,2,3

Problem Based Macro Contexts in Science Instruction: Design Issues and Applications Development

Anthony J. Petrosino **Xiaodong Lin**

This session outlines a number of issues related to the development and application of a constructivist model of instruction which we call Anchored Instruction and the implications this model has for science education. We describe this evolving theory of instruction, provide examples of projects that have used the design principles, briefly summarize related research findings, and indicate some of the opportunities for teachers as they implement these designs.

Sherwood, Robert D. **Session 4.03** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

The "Scientists in Action Project": Field Studies and Internet Development Activities

The Cognition and Technology Group at Vanderbilt

Our goal in the proposed poster session is to outline a number of issues related to the development, field testing, revision, and extension of a National Science Foundation sponsored middle school science curriculum development project, *Scientists in Action*. The poster will be divided into four major segments which will include; (1) some of the issues that have lead the group to the design principles of the project, (2) briefly summarize some of the research studies undertaken to support our work, (3) provide a running demonstration of some of the series materials, and (4) demonstrate plans to move the series to an Internet based platform.

Shiao, Yueh-Suey **Session 7.07** **Saturday, March 22, 1997**
12:00pm-1:00pm
Regency B

Elementary Children's Concepts of Living Things, Animals, and Plants in Taiwan

John E. Penick

This interpretive study investigated three biological concepts, *living things*, *animals*, and *plants*, held by fourth graders in Taiwan and compared them with those held by teachers and presented in textbooks. Four teachers and 24 students from four elementary schools on the east coast of Taiwan participated in this study. Students' and teachers' defining attributes of the three concepts were analyzed from different tasks including written sets involving listing, identification, and problem solving and interview tasks of definition and follow-ups of written tasks. This study found that most of the fourth graders' three concepts were not coherent and were different from those of biologists. Generally teachers' three concepts were more biologically acceptable and coherent than students, but not as scientific and coherent as would be desired. The students' three concepts did not much resemble either those of teachers or textbooks. The concept of *living things* was much more difficult than the *animal* or *plant* concept. However, the textbooks introduced the three concepts in the opposite order from *living things* to *plants* or *animals*.

Shimizu, Kinya **Session 12.10** **Sunday, March 23, 1997**
10:30am-12:00pm
Ogden

Teachers' Emphasis on Inquiry Science and Prevailing Instructional Method

The purpose of this study is to examine the prevailing instructional method utilized by inquiry-oriented science teachers. The first part of the study focuses on measurement of the teaching emphasis on inquiry science. Exploratory factor analysis of various teaching emphases revealed four factors: (1) development of inquiry skill in science; (2) development of affective domain in science; (3) development of awareness of the humanistic side of science; and (4) development of knowledge and understanding in science. First, the proposed study will examine the relationships among these four factors in more detail through a structural equation model. Second, the relationship between teachers' emphasis on inquiry science and their classroom practice will be explored. The results of the two structural equation models indicate that teachers' views of scientific inquiry are influenced by inductive empiricism. Although an emphasis on inquiry science is the most influential factor in the hands-on science approach, it does not have a significant effect on classroom discussions. Instead, affective science and equipment problems show positive effects on classroom discussion. In other words, teachers use classroom discussion merely as a strategy to motivate students who are neither oriented to academic science nor surrounded by scientific facilities.

Shipman, Harry L. **Session 7.02** **Saturday, March 22, 1997**
12:00pm-1:00pm
Kent 1,2,3

Design Activities in a Big, Interdisciplinary Physical Science Course

Ramona Philhower

We report on our successful introduction of 6-week, inquiry based experiments and projects into the curriculum of a large, interdisciplinary science course. In our pilot study, 48 students in two laboratory sections devised their own experiments or built their own devices when given only rather general guidelines. Students described their projects at a university- wide poster show. Poster judges were colleagues from other institutions. Our success measures are student satisfaction, student learning, and staff tolerance of the extra work. Our evaluation also shows just what students learn from design activities like those found in many Science Olympiads. This curricular change resulted from and fostered a lot of collaboration. The authors of this paper, a physics professor and an elementary teacher who was then teacher-in-residence at the University, led the effort. Faculty and teaching assistants from biology, education, geology, and physics helped in major ways. The poster show brought colleagues from mathematics, allied health, physics, and education from two other institutions together and into the picture.

Sinclair, Becky Barton **Session 9.13** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency E

The Effect of Inservice Training and Teachers' Action Research on Elementary Science Classroom Environments

Barry J. Fraser

The study involved (1) the development and validation of questionnaires to assess elementary school science students' perceptions of classroom environment and (2) an evaluation of the effectiveness of inservice training on the topic of classroom environment, combined with teachers' participation in action research involving the use of feedback on actual and preferred classroom environment in promoting improvements in classrooms. The experimental group consisted of 60 elementary teachers who attended the inservice course and who attempted to improve the environment of two of their classes (a total of 120 classes). An actual and a preferred classroom environment questionnaire assessing Cohesion and Cooperation, Teacher Support, Task Orientation, Involvement and Equity was administered as a pretest, then teachers planned interventions aimed at reducing actual-preferred discrepancies, and finally the actual form of the questionnaire was readministered as a posttest A control group of 60 teachers administered the same questionnaire to 120 classes. Factor and item analyses supported the internal consistency reliability and five-factor structure of the questionnaire for two units of analysis (individual student and class mean). Overall, desirable changes in classroom environment were considerably larger for the experimental group than for the control group, thus supporting the efficacy of environmental change strategy.

Siner, Suzanne A. **Session 10.04** **Saturday, March 22, 1997**
4:00pm-5:30pm
Oak Brook I

Expectations of Expertise: The Case of an Elementary School Science Specialist

This case study, based on a two year collaborative research project, was designed to elucidate what shaped the professional context and knowledge of an elementary school science specialist. The science specialist faced a number of challenges related to working as a content "expert" in a culture composed primarily of content "generalists," and to achieving both content focus and curricular integration. For example, the science specialist was responsible for the development of science content standards, yet despite the school's stated goal of "curricular integration" classroom teachers were not involved in the process. With respect to teaching science, some teachers were reluctant to participate as a result of their weak science background, while others abdicated responsibility for the science program because of the expectation the specialist would be responsible for both providing subject matter expertise as well as achieving integration with other disciplines. Thus, while the work of the science specialist required collaboration with classroom teachers the specialist often faced professional isolation. This situation highlights the need for a schoolwide agreement about the role and function of the specialist in order to facilitate the specialist-teacher-principal collaboration.

Slough, Scott **Session 4.01** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Development of a Framework for the Evaluation of Children's Literature in the Teaching of Science

Robin McGrew-Zoubi **Jeannine St. Pierre-Hirtle**

The purpose of this study was to develop and evaluate an instrument entitled: Framework for the Evaluation of Children's Literature in Teaching Science. This paper presents the development and testing of this instrument. The Framework was piloted in an evaluation of children's literature selections on the science concept of weather by preservice teachers in an elementary science methods course. By using the Framework, at least five types of conceptions consistent with the literature on weather conceptions were identified, supporting the need for a more thorough evaluation of these children's literature selections before they are used in the teaching of science.

Smith, Coralee **Session 9.09** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency A

Self-Efficacy and Anxiety of Preservice and Inservice Elementary Teachers Related to Learning

Students enrolled in science methods courses at a major land grant university in the southern USA were the subjects in this study. Undergraduate and graduate students were administered three different instruments: the Science Teaching Efficacy Beliefs Instrument, Zuckerman's Science Anxiety Scale, and the Learning Cycle Test. The STEBI provides scores on Self Efficacy and Outcome Expectancy subscales. The Zuckerman instrument produces a score indicative of the respondent's anxiety toward science with higher scores representing greater anxiety. The Learning Cycle Test is a two-tier instrument that assesses students' understandings of the three phase learning cycle. For the undergraduates, the strongest correlation was found between self-efficacy and outcome expectancy scores but correlations with the learning cycle for all measures were weak. Graduate student data revealed negative correlations between scores on the Zuckerman instrument and both STEBI subscales. Correlations for all measures with the learning cycle were similarly slight for the graduate students.

Smith, Darwin W. **Session 9.06** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Formative Assessment and Conceptual Change in Preservice Middle Grades Teachers' Understanding of Physical Science

Katherine C. Wieseman

Middle school science teachers need a good understanding of physical science, yet this is an area where many preservice students have great difficulties. Our students' fears and our concern for their understanding of science concepts prompted us to undertake an expiatory case study to evaluate and improve the learning environment in a physical science course designed for prospective teachers. The study focused on three questions: (1) How did an approach to assessment which involved individual and small group discourse influence students' explanations of physical phenomena? (2) How did middle grades preservice teachers explain certain physical phenomena, as presented in test items?; and (3) Which alternative explanations were particularly resilient to reconceptualization? This collaborative research study was begun during the winter 1996 academic quarter by the co-presenters (a chemistry professor who served as the instructor and a science education graduate student who occupied a dual role in the class as a special student and a teaching assistant). Based on preliminary findings, instructional methods are being modified and the study is being continued for the Winter Quarter of 1996.

Southerland, Sherry A. **Session 9.11** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency C

Refining Conceptual Change Theory: Examining the Influence of Student Characteristics, Conceptual Domain, and Research Epistemology

The objective of the research was to further refine the application and boundaries of conceptual change theory. The process of theory refinement was informed by (a) a micro-description of the process of learning within a specific science content and (b) the identification of factors that influence the pattern of knowledge restructuring. Four high school biology students were interviewed throughout the school year to describe their conceptions related to biological evolution. Examination of the conceptual restructuring that occurred revealed that much learning does not follow the holistic path described by the conceptual change theory. Instead, the fluid actions of components of students' conceptual ecologies and the nature of the content to be learned play important roles in determining the type of conceptual change that will occur.

Soyibo, Kola **Session 13.05** **Sunday, March 23, 1997**
2:30pm-3:30pm
Kent 1,2,3

Jamaican Students' Understanding of the Processes of Diffusion, Osmosis and Absorption Across Living Cells

Marcia Andrade

One hundred and sixty six tenth-graders, selected from seven high schools in Jamaica, were assessed on their understanding of the processes of diffusion, osmosis and absorption across living cells by means of four concept evaluation statements developed by the authors. The students' teachers and their biology textbooks were examined to establish if they were sources of their alternative conceptions on the three processes/concepts. Results indicated that none of the students had a sound understanding of any of the concepts but they exhibited a general lack of understanding and few misconceptions. A partial understanding of diffusion, osmosis and absorption was shown by 13.3%, 6.6% and 9% of the students respectively. The level of lack of understanding shown by the students, in descending order, was: absorption (79.5%), diffusion (59%), and osmosis (36.1%). The students' biology textbooks and some of their teachers appeared to be possible sources of the students' lack of understanding, misunderstanding and alternative conceptions on the concepts. The students' alternative conceptions seemed to originate from their teleological and anthropomorphic ideas on the three concepts.

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Speering, Wendy

Session 12.08

Sunday, March 23, 1997
10:30am-12:00pm
Oak Brook III

Science: It's a Very Good Subject If...

Léonie Rennie

The purpose of the study was to investigate the effects of transition between primary school and high school on students, particularly girls, who were enthusiastic about science at the end of primary school. At the 1996 NARST meeting, the story of Jane was presented as an illustration of a student whose attitude to science declined in the first years of high school. This year, a case from the second stage of the study is presented as an example of a student whose interest in science was fostered by an exemplary high school science teacher. In the context of the broader project, the two case studies clarify the links between students' perceptions of science and school factors such as teaching strategies and the teacher-student relationship.

Starr, Mary L.

Session 9.02

Saturday, March 22, 1997
2:45pm-3:45pm
Kent 1,2,3

Elementary Preservice Teachers' Use of Content Specific

The content specific pedagogical strategies used by three pairs of first year preservice elementary teachers are described. The preservice teachers taught three consecutive lessons during the first and second semester while participating in a preparation program focused on integrating science content, methods, foundations, and practicum. Multiple data sources -- teaching videotapes, pre and post teaching discussions, and teacher beliefs interviews -- were used to describe the instructional episodes and the preservice teachers' decision making. Three main aspects of preservice teachers' science content representations were examined– how they represented concepts, how those representations reflected the needs of learners, and how they managed participation, resources, and time to facilitate carrying out the representations. Findings indicate that by the end of the first year of teacher preparation, preservice teachers' began to use multiple content representations, both commonly known representations and those they create. They attempted to develop students' understanding of the nature of scientists' work and emphasized the nature of scientific ventures in their teaching. They enacted lessons using various teaching techniques and focus on students' cognitive engagement rather than solely on student interest. They had problems linking science content representations. Finally, the preservice teachers' instruction was very teacher directed, limiting opportunities for students to explore ideas independently.

Staver, John R.

Session 8.12

Saturday, March 22, 1997
1:00pm-2:30pm
Regency F

Constructivism: Excellent Theory for Explicating the Practice of Science and Science Teaching

My purposes herein are to respond directly to Osborne's (1996) critique of constructivism and indirectly to others (e.g. Matthews, 1992, Phillips, 1995) criticisms, and also to support my own and others (e.g. Tobin 1993, von Glasersfeld, 1995) assertions that constructivism is an excellent theory with which to explain the practice of science and science pedagogy. The paper is organized into three parts. In the first part, I briefly delineate constructivism as an epistemology by recounting its purpose, nature, and orientation. In the second part, I discuss the long standing epistemological issue of truth and knowledge and explicate how each is successfully addressed within a constructivist epistemology. In the third part, I employ truth and knowledge within a constructivist view to point out the value of constructivism in explaining and interpreting the practice of science and science pedagogy.

Stein, Mary **Session 9.10** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency B

Assessing the Impact of an Urban Systemic Professional Development Program on Classroom Practice.

John Norman **Juanita Clay Chambers**

The challenges faced by urban schools as they aspire to reform science education are immense. Under the auspices of the National Science Foundation, through the Urban Systemic Initiative (USI), teachers and administrators throughout the Detroit Public School system have been deeply involved in a wide array of professional development activities. Although there are many components to the Detroit Urban Systemic Initiative (DUSI), the infusion of extensive professional development opportunities holds great promise to positively impact classroom practice. Systemic Evaluation of the DUSI is multi-faceted and targets a variety of outcomes. This study focused on the impact of DUSI professional development activities on actual classroom practice. Data was collected using a variety of methods including student and teacher surveys, school team case studies, and reports from teacher and administrator focus groups. Evaluation of professional development activities revealed that the overall program is of high quality and tightly aligned with constructivist teaching and learning practices. Results indicated that teachers reported a significant increase in implementing constructivist teaching and learning practices that can be attributed to involvement in DUSI professional development activities.

Sterling, Donna **Session 17.07** **Monday, March 24, 1997**
10:30am-12:00pm
Regency A

Stages of Conceptual Change That Enable Teachers to Adopt a Student-Centered Approach to Hands-On, Inquiry-Based Teaching

The Project Alliance summer programs provides professional development for middle school teacher teams to design integrated, hands-on, inquiry-based environmental science units and disseminate the team planning and teaching process. The three main areas for development during the summers were subject matter, pedagogy, and leadership. Daily observations, interviews, focus groups, and surveys provided data to help staff determine /identify obstacles to be overcome as teachers developed integrated, inquiry-based environmental science units, and dissemination plans. A series of seven stages of conceptual change were identified and corresponding activities created to help the teachers progress through the change process that was necessary for them to develop integrated science units which were both hands-on and inquiry-based. These findings and others will be discussed.

Stohr-Hunt, Patricia M. **Session 7.12** **Saturday, March 22, 1997**
12:00pm-1:00pm
York 1,2,3

A Psychometric Analysis of Performance Assessment Tasks Measuring the Inferring Skills of Fourth Grade Students

This study involved the development and analysis of a paper and pencil test and a performance test designed to measure the skill of inferring. The paper and pencil test was composed of 25 multiple choice questions, while the performance test was composed of four performance tasks, parallel in format, though differing in content, context and materials used. Data were analyzed for 246 students, with 131 males and 115 females. These subjects were fourth grade students drawn from four school districts in western New York, representing urban, suburban, and rural communities. The reliability estimates for the paper and pencil test and the performance test were .78 and .68 respectively. The reliability estimates for the individual tasks ranged from .69 to .92 (when converted to the total test size). Intensive efforts were made to control for the "surface features" of the tasks, such as format, number of questions, and type of questions. However, there was substantial variance by task, with the correlation among tasks ranging from .13 and .30. The performance test was significantly correlated with the paper and pencil test, though modestly, at .48.

Stratford, Steven J. **Session 14.09** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency D

Technological Artifacts Created by Secondary Science Students: Examining Structure, Content, and Behavior of Dynamic Models

The purpose of this study was to explore the structure, content, and behavior of dynamic model-artifacts created by ninth grade science students. The one hundred students, enrolled in a technology-enhanced, project-based classroom, used dynamic modeling software called Model-It. After learning how to use the software, they worked in pairs for several days in a classroom setting to create models of their own design based upon suggested stream ecosystem scenarios. The structure, content, and behavior of each model was assessed against given criteria in order to determine the characteristics and quality of the models. Results indicated that most models exhibited unified coherency; accurate content in factors, relationships, and explanations; and medium or high fidelity behavior over time. The results of this study suggest that the students who created these models created coherent, accurate and reasonably behaved models that made sense and were non-trivial. Thus, the creation of dynamic model-artifacts provides students with a meaningful way to represent scientific knowledge and understandings of the visual, conceptual, and behavioral aspects of a phenomenon.

Stubbs, Harriett **Session 3.09** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook IV

Evolving from Teacher to Teacher Leader: The Challenge for Change

Ann Howe

There is widespread recognition that successful education reform will require new approaches to the professional development of teachers. The standards included in the National Science Education Standards are welcome guideposts that must be implemented by those in the field. Over the past five years we have developed, through the SCI-LINK Project, a process for the professional development of science teachers that has now reached approximately 1000 participants. From among these teachers there has arisen a group of 60 Master Teachers who have become capable and effective leaders. These teachers have become leaders in professional development activities that promote increased knowledge of science teaching, improved classroom practice and the disposition toward lifelong learning. Case studies of two of these Teacher Leaders will be presented. One is a Caucasian woman in a growing urban system; the other is an African American woman in a small conservative town. Both have taught for more than twenty years. Factors associated with the success of the program and barriers to the development of Teacher Leaders will be discussed.

Stuessy, Carol **Session 8.03** **Saturday, March 22, 1997**
1:00pm-2:30pm
Kent 1,2,3

Setting the Stage for Strengthening the Science Preparation of Elementary Teachers in Texas

Julie A. Thomas

The purpose of this study, which was performed by an action team established by the Texas Statewide Systemic Initiative, was to develop *Guidelines* that reflect the perceptions of major stakeholders in elementary science teacher preparation regarding the "ideal" preparation program for the state of Texas. These *Guidelines* would then be used in a discrepancy model to compare the "ideal" state of elementary science teacher preparation and practices with the "real" state, as gleaned from three research studies that follow this paper. The *Guidelines* specifically address the science needs of prospective elementary teachers, including the content and structure of science courses and experiences for their preparation, induction, and continued growth as teachers of science. The iterative process of writing the *Guidelines* involved the production, editing, and revision of draft documents among focus groups of teachers, administrators, inservice personnel, and college and university instructors from fields of science and education. Focusing on the review and revision of the document by these stakeholders led to collaboration, consensus, and capacity among those ultimately responsible for changing the ways in which elementary science teachers are prepared. Six guidelines comprise the final document: Collaboration, Content Courses, Student-Centered Teaching, Inquiry, Field Experiences, and Continued Professional Development.

Svec, Michael **Session 16.01** **Monday, March 24, 1997**
8:30am-10:00am
Hunt 1,2,3

Understanding National Standards: An Evaluation of a Professional Development Program for Mathematics Teachers

The purpose of this study was to evaluate the effectiveness of the MATHLINE professional development program. The MATHLINE Project is an integrated set of activities and materials that focus on systemic change. MATHLINE employs video tapes demonstrating Standards-driven instruction, online interaction with other teachers, online access to a mentor, and the opportunity to participate in two national interactive video conferences. Participants included 120 elementary and middle school teachers from diverse settings. Data were obtained from pre- and post-program surveys, observations of on-line discussions, teacher journals and selective interviews. The results indicate that the MATHLINE project has had a positive influence on how teachers see themselves, on their beliefs and attitudes towards mathematics and teaching math, and on their understanding of the NCTM Standards. Teachers have reported that are increasingly engaging the NCTM Standards and have changed their math classroom environments to be more consistent with the math standards. The implication is that MATHLINE provides a model program which the science education community can duplicate for preparing science teachers to implement the National Science Education Standards.

Talsma, Valerie L. **Session 14.01** **Sunday, March 23, 1997**
4:00pm-5:00pm
Hunt 1,2,3

Scientist as "Self" and "Other": Changing Images of Scientists in a Middle-School Project-Based Science Classroom

This paper reports on part of a larger, ethnographic study in a sixth grade middle school classroom that is attempting to adopt project-based science (Blumenfeld, 1991). One of the emphases of the classroom teacher is that, during the course of the year, the students will be scientists in the classroom. Classroom instruction focused on authentic investigations of the students' environment, role-playing of scientists, and a post-modernist emphasis on how scientists "do" science. This study looks at how these emphasis affected students conceptions of scientists over the course of the 1995-96 school year. It was hypothesized that with the strong emphasis of "student as scientist" in the classroom coupled with the post-modernistic approach to science, that students would come to depict scientists with fewer stereotyped features and more characteristics shared by the student. Preliminary analysis reveals that the hypothesis was partially supported. Over the course the year, students included fewer physical stereotypical features of scientists in their drawings and were more likely to draw a scientist as the same race as their own. Some students also reported that they had based their later drawings on themselves.

Tao, Ping-Kee **Session 10.09** **Saturday, March 22, 1997**
4:00pm-5:30pm
Regency B

Conceptual Change in Science Through Collaborative Learning at the Computer

Richard Gunstone

The purpose of this study was to investigate whether and how collaborative learning at the computer fosters conceptual change. A suite of computer simulation programs was developed to confront students' alternative conceptions in mechanics. This was integrated into a 10-week physics instruction of a Grade 10 science class in a Melbourne high school. A Conceptual Test was administered to the class as a pre-, post- and delayed post-test to determine students' conceptual change. Students in the class worked collaboratively in dyads on the programs carrying out predict-observe-explain tasks according to a set of worksheets. The tasks were designed to provide cognitive conflicts that facilitated conceptual change. While the dyads worked on the tasks, their conversational interactions were recorded. A range of other data were also collected at various junctures during instruction. Case studies of collaboration were written up for seven dyads. The study showed that the computer-supported collaborative learning provided students with experiences of co-constructions of shared understanding and peer conflicts which led to conceptual change for those who were prepared to reflect on and reconstruct their conceptions.

BEST COPY AVAILABLE

Taylor, Peter **Session 17.11** **Monday, March 24, 1997**
10:30am-12:00pm
Regency E

Telling Tales that Show the Brushstrokes

In this paper, I make a case for the use of impressionistic tales as a valuable new genre for shaping and representing the fieldwork experiences of interpretive researchers in science education. I illustrate my argument with two impressionistic tales whose central semi-fictionalised characters are based on recent fieldwork amongst teachers of college science and mathematics in Florida. Arising from this research is the question of the legitimacy of impressionistic tales. Because impressionistic tales are allied with literary genre, rather than the traditional genre for reporting scientific research, new standards of judgement are called for in determining their research status. Some of these fit comfortably with existing standards and some do not.

Thau, Allison **Session 7.05** **Saturday, March 22, 1997**
12:00pm-1:00pm
Oak Brook IV

What Do Children Learn While Visiting a Museum Exhibit?

The purpose of this study was to measure the extent of learning that occurred as students participated in a visit to a museum exhibit. The 985 elementary and middle school students spent one hour with the exhibit during which systematic observations were conducted. The framework for the design of the exhibit was built upon theoretical contributions from constructive learning, intrinsic motivation, and socially-facilitated learning Appropriate teaching strategies and activities were selected based on the needs and concerns expressed by the classroom teachers prior to the visit. The central feature of the evaluation was the examination of the changes in knowledge and attitude which resulted from exposure to the tasks engaged in by students. Following the visit each student responded to an interview questionnaire. The goal was to determine what the visitors "came away with" after seeing the amber exhibition. Results indicated that all student experienced significant increase in learning during the visit. Statistical analyses conducted on the interview results supported the overall aim of the exhibit.

Thomas, Julie **Session 6.06** **Saturday, March 22, 1997**
10:30am-12:00pm
Hunt 1,2,3

Paradigm of Change: Doing Math the Science Way

Christine Purkiss **Sandi Cooper**

The purpose of this qualitative study was to explore how an in-service program could help improve teachers' self-efficacy and understand how that affects teachers thinking about integrated curricula. Twenty-four elementary teachers were involved in an intensive three-week summer program designed to increase their knowledge of earth science concepts and how to integrate mathematics with these concepts. Qualitative data was collected and a constant comparison analysis was performed on the data. Four themes emerged from the data that suggest that this type of in-service program does support improved teacher self-efficacy. The four themes were: 1) Understanding integration; 2) Pride in content ownership; 3) Enhanced peer interaction; and 4) Empowerment.

Tobin, Kenneth **Session 12.11** **Sunday, March 23, 1997**
10:30am-12:00pm
Windsor

Cultural Diversity and the Challenges of Teaching Science

Chris Muire **Nancy Davis**

Teacher and student roles in elementary and middle school science classes employed textbooks, worksheets and lectures. Teachers did not use materials and laboratory activities appreciably, even though they were regarded as important. Computers and interactive media also were viewed as important but were not used extensively. Approaches to assessment emphasized the use of fill in the blank and multiple choice items although teachers used portfolios and endeavored to involve learners in self assessment. The participation in science of females and minorities was not highlighted, nor were potential applications of science to the world of work. Against such a background teachers endeavored to change science curriculum to meet the needs of students who were mainly Haitian, Hispanic or African American, lived in poverty, and faced the challenges of single parent homes, poor health, unemployment, crime, and violence. Teachers and students were constantly challenged in teaching and learning science by social and cultural phenomena associated with the diverse histories of the students. The paper examines cultural capital, linguistic imperialism, and such social phenomena as symbolic violence in diverse science classrooms.

Towns, Marcy Hamby **Session 3.04** **Friday, March 21, 1997**
7:00pm-8:30pm
Cermak

Student Perspectives of Cooperative Learning Activities

Kelly Kreke

The purpose of this study is to understand what cooperative learning activities in an undergraduate chemistry course meant to the students. Cooperative learning activities were used throughout the course with one class session per week being entirely devoted to such activities. An analysis of field notes and a questionnaire yielded three findings from the perspective of the students. First, these cooperative learning activities create an environment characterized by intellectual challenge and encouragement which produces a warmer classroom climate. Second, the interactions between students provide them with an opportunity to develop the interpersonal skills and communication skills necessary for success in the workplace. Third, these activities give students the opportunity to focus on the material in order to draw connections between concepts. These findings allow us to add breadth and depth to our understanding of positive cooperative learning outcomes such as achievement gains, increased positive attitudes, and increased self-esteem.

Trax, Mark F. **Session 8.13** **Saturday, March 22, 1997**
1:00pm-2:30pm
York 1,2,3

Voices of Reform: Partners – Teacher to Teacher

Teacher participants, in a major teacher enhancement project in the Midwest, from the high school and middle school levels have become actively involved in science education reform of their classrooms, departments, buildings, and districts. This has been accomplished through inservices, workshops, meetings, and site visits. These activities were employed to recruit, educate, and develop a cadre of committed science teachers. To determine the level of commitment, understanding, and collaboration between teachers, semi-structured audiotaped interviews were conducted. Questions were designed to elicit teachers' perceptions of the types of partnerships, the level of collaboration present, and the impact that this collaboration had on the reform process in their schools. Participants were also asked to complete a questionnaire using a Likert scale and an open ended response section. Data gathered were categorical and interval, hence statistics used were frequencies, percentages, and medians. Highly ranked items and the most significant effectors of change will be highlighted.

Treagust, David F. **Session 9.11** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency C

A Multi-Dimensional Interpretive Framework for Understanding Conceptual Change Learning

Grady Venville **Allan Harrison** **Louise Tyson**

Our current work to gain a better understanding of learning involves analysing and interpreting data from a variety of classroom situations in different science content areas. Our analyses of conceptual change learning episodes indicate that classroom learning - whether within a single lesson or over a year - should be interpreted from more than one theoretical perspective due to its complexity and multi-dimensional nature. Consequently, as a means of triangulating different theoretical perspectives of conceptual change for interpreting these classroom learning situations, we have developed and use a multi-dimensional interpretive framework. In this paper, we describe the multi-dimensional interpretive framework and illustrate how a clearer understanding of conceptual change learning in secondary science classrooms eventuates when analysed from the different theoretical perspectives within this interpretive framework.

Treagust, David F. **Session 3.08** **Friday, March 21, 1997**
7:00pm-8:30pm
Oak Brook III

Learning Science: An International Perspective

Reinders Duit **John Gilbert** **Carol Boulter** **Bill Cobern**
Glen Aikenhead **Phil Scott** **Rosalind Driver**

This international symposium brings together informed research on the contribution of different perspectives to learning science. Each of the authors, from four different countries, has contributed to a section of the soon-to-be-published International Handbook of Science Education by Kluwer Academic Publishers. Each author will present a research perspective on learning science that includes an overview of the chapters of the Handbook, an examination of learning science from behaviourism to social constructivism, learning science through models and modelling, cultural aspects of learning science, and learning about science teaching based on an action research project

Trowbridge, John **Session 13.09** **Sunday, March 23, 1997**
2:30pm-3:30pm
York 1,2,3

Can Students Distinguish Between Science and Technology

James Wandersee

The ability to distinguish between science and technology is now a "standard" for current science teaching and curriculum planning. In many cases high school students do not distinguish between the roles of science and technology. This study of high school students found restricted notions of science and technology. Frequently students' notions of technology were restricted to a *positive* application or an advancement of science. Students did not recognize that technology can proceed on its own, without a science connection. Furthermore, there is little recognition that technology can be applied in a harmful manner or can be applied to anything else other than service to humans. Technology was characterized as being mechanical or electronic in nature. These findings and others have ramifications for the continued definition of scientific literacy.

Tuan, Hsiao-Lin **Session 3.10** **Friday, March 21, 1997**
7:00pm-8:30pm
Ogden

The Development of a Questionnaire for Assessing Student Perception of Teacher Knowledge in Taiwan and Australia

Huey-Por Chang **Kuo-Hua Wang** **David F. Treagust**

This paper reports part of a cross-national study of science classroom environments in Taiwan and Australia. Specifically, it focuses on the development and validation of a questionnaire to assess student perceptions of four dimensions of teachers' knowledge: Instructional Repertoire, Representational Repertoire, Subject Matter Knowledge, and Knowledge of How to Assess Students' Understanding. The development process included the translation of the English version into Chinese, the independent back translation of the Chinese version into English again by people not involved in the original translation, and subsequent changes to the wording where necessary. Further refinements were made based on interviews with teachers about their comprehension and interpretation of items. Administration of the questionnaire to 100 teachers of grade 7–9 science classes in Taiwan and Australia supported each scale's internal consistency reliability and a priori factor structure.

van den Akker, Jan **Session 10.13** **Saturday, March 22, 1997**
4:00pm-5:30pm
York 1,2,3

Science Curriculum Implementation: Perspectives from the International Handbook of Science Education

Rodger Bybee **Nava Ben-Zvi** **John Wallace** **William Louden**
Wilmad Kuider **Ronald D. Anderson**

Studies on science curriculum implementation usually reveal a huge gap between proclaimed curriculum ideals and their realization in educational practices (at many levels). Considerable tension between emerging ideals (as expressed in the intended curriculum) and current practice is, itself, not problematic – one might even say that without such tension there is no need for curriculum reform initiatives. However, the lack of impact of such endeavors on average classrooms processes (operational curriculum) and student outcomes (attained curriculum) has often led to frustration and cynicism, sometimes resulting in too simplistic criticism and one-sided blaming of specific groups. It is the objective of this symposium, discussing these problems from multiple perspectives, to contribute to a better understanding and more balanced approaches of science curriculum reform efforts. It is hoped that the international nature of the symposium, bringing research-based information and insights from scholars in different countries together, will increase the significance of the debate and its conclusions. Common to all five contributions to this symposium is the viewpoint that only systemic approaches, with convergent measures at various influential areas, and with a clear focus on the needs and concerns of teachers, can bring about real and lasting curriculum changes.

Van den Berg, Ellen **Session 16.01** **Monday, March 24, 1997**
8:30am-10:00am
Hunt 1,2,3

Long Term Impact of Inservice Education: Participants Revisited a Year Later

The purpose of this study was to investigate the long term impact of an introductory inservice education program. This program aimed at supporting teachers to implement a constructivist approach to elementary science. The more long term impact was studied by means of an exploratory case study guided by a conceptual framework based on factors influencing implementation processes. Results indicated that an introductory inservice program may sort a *propelling effect*. The magnitude of this effect depended on the organizational and cultural contexts of the teachers' schools, but also on their individual characteristics and personal histories. These factors shaped the way the teachers implemented the intentions of the inservice program to a large extent. As a consequence there was a rich variety in the way the teachers tried to reform their elementary science program.

Van Sickle, Meta **Session 17.05** **Monday, March 24, 1997**
10:30am-12:00pm
Kent 1,2,3

Changing Constructs of Secondary Science Student Teachers: Using Concept Maps to Trace the Pedagogical Thinking

Carolyn Dickman John Sears Katherine Norman

A two year long multiple case study was conducted on secondary science student teachers to learn what connections, if any, they made among the concepts of the natures of science, technology, and pedagogy in the United States. The same study covered a one year period in England. The data were collected in the form of concept maps, interviews, and classroom observations. Initial concept maps were collected before student teaching began. Analysis of the data occurred with each set of concept maps collected. Constant comparison of the data began at the onset of data collection. The students were generally unable to draw any connection between science and pedagogy at the first data collection, and were unable to complete any concept map with regard to technology. The number of connections increased to 50 among the constructs of the nature of science, the nature of technology and the nature of teaching. Concept map analysis using both scoring rubrics and qualitative techniques indicate that students with systems types of thinking are more satisfied and more able to adapt to classroom situations than their more linear thinking peers.

Varanka-Martin, MaryAnn **Session 16.07** **Monday, March 24, 1997**
8:30am-10:00am
Regency D

The Fate of an All Girls' Physics Class: A Reflection of Society

This ethnographic study of the processes, concerns and events associated with the continuation of a gender-sensitive physics class in a small, rural, public high school identifies factors affecting the noncontinuance of this course offering. The factors are examined in light of the three requirements for the support and continuation of gender-sensitive environments – women's and girls' needs for contexts in which to voice their experiences, needs and identified solutions; decision making power; and access to people in positions of power. Barriers to continuation of this all girls' physics class include concerns about legal compliance with Title IX, the needs of boys in science education, and the implicit coercion of a federal request for information. The solicitation of information in this case and the potential for similar requests and investigations in other single-gender classes elsewhere cast a shadow over the continuation of such opportunities for girls and the possibility of research in these educational settings. For re-institution of this or implementation and/or continuation of other gender-sensitive environments that are single gender in nature, social or political action may be necessary. Social/political action requires contexts in which women and girls voice their experiences, needs, and identified solutions, have decision--making power, and access to people in positions of power.

Varrella, Gary F. **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

Expertise in Inservice Science Education; Relationship Between Science Teachers' Beliefs and Practice Year II

This paper looks at the consistency between how teachers actually teach and what those teachers think about the learning environment. The central role that epistemology plays in teachers' personal beliefs about teaching and corresponding day-to-day practice serves as the basis for this work. This study subscribes to the perspective that teachers build conceptual structures which influence their daily teaching. For the more expert teacher a corresponding richness of personal beliefs is reflected and demonstrated through the complexity and effectiveness of their constructivist teaching habits. A newly developed evaluative rubric used to measure teacher's individual perceptions of the relationship between the students and the instructor in the learning environment was used to quantify the teachers' perceptions of their beliefs. The belief rubric and the Science Classroom Observation Rubric from the ESTEEM are used in this paper.

Varrella, Gary F. **Session 8.13** **Saturday, March 22, 1997**
1:00pm-2:30pm
York 1,2,3

Voices of Reform: The Expert Science Teacher and the Relationship of Beliefs to Practice

Robert E. Yager

The relationships between proficient-to-expert teachers' practices and corresponding and/or conflicting beliefs about teaching and learning will be the focus of discussion. Data used to analyze these relationships are a subset from a larger study whose broad purpose was to investigate the relationships between teacher beliefs and constructivist teaching. Three separate instruments were used to gather data. The data were gathered during the 1994-95 and 1995-96 school years and include classroom observation/evaluations, teachers' written responses related to personal beliefs, and responses to a questionnaire using a Likert scale. A factor analysis was used to develop the author's original belief rubric using a principle component solution with an orthogonal rotation accounting for 81% of the variability. A previously established constructivist teaching rubric and a self assessment of teaching practices served as the other two data gathering instruments. Relationships among the variables were explored using correlation methodologies. The different data sources enhanced validity - the design was mixed with a quantitative emphasis.

Vopava, Judy **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

Expertise in Preservice Science Teaching Across 10 National Sites: The Salish Project Year III

The Salish Consortium is the first an only project sponsored by the Council of Scientific Society Presidents (CSSP). It was developed to evaluate 10 national science and mathematics preservice programs. *The Salish Consortium* is researching, evaluating and using its new knowledge to develop improved teacher preparation. Salish is assessing key variables in preserve education programs, then measuring the recent graduates, and following their progress during the first three years of the new teaching careers. The project is linking the teaching variables to their teacher preservice program variables. The data are to be publicly debated and integrated into a redesign of mathematics and science preservice education across the ten institutions. The results of the first year data analysis at the program and teacher levels will address commonalities and unique characteristics of the 10 sites. Data will be presented across student, teacher, and program levels.

Waldrip, Bruce G. **Session 12.08** **Sunday, March 23, 1997**
10:30am-12:00pm
Oak Brook III

Cultural Learning Environments in Science Classrooms: Validity and Application of a Questionnaire

Darrell L. Fisher

The purpose of this study was to develop and validate an instrument to assess science students' cultural environment, and to examine associations between these cultural environments and students' attitudes to wards science. A measure of students' cultural environment, namely the Cultural Learning Environment Questionnaire (CLEQ), was developed. The instrument was based on Hofstede's four dimensions of culture (Power-Distance, Uncertainty-Avoidance, Individualism, and Masculinity-Femininity) and contained eight scales. Using a sample of 2000 secondary science students, the reliability of the CLEQ scales ranged from 0.67 to 0.84 and showed acceptable discrimination between the scales. The mean correlation between scales ranged from 0.05 to 0.16. The authors' view reporting of the class or school mean as somewhat meaningless as this instrument was designed to measure students' personal cultural environment. An examination of the diversity of cultural environments in each classroom was indicated by examining the standard deviations of each scale for different classrooms. For example, the standard deviations of the scale, Gender Differentiation, ranged from 0.4 for a conservative private all girls classroom to 0.72 for a multi-ethnic public high school classroom. Relationships between students' cultural environment and attitudes were examined.

Wallace, John **Session 7.09** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency F

Sociocultural Influences On The Classroom Learning Environment

Ching-Yang Chou

The research reported in this paper is part of a larger Australia-Taiwan cross cultural study into science classroom learning environments. This paper reports on data collected from two science classrooms (one grade 5 and one grade 8) in the state of Western Australia. This interpretive study investigates teachers' and students' understanding of the nature of the classroom learning environment. In particular, the study focuses on the socio-cultural factors contributing to similarities and differences in understanding between students and between students and their teachers. Preliminary findings indicate that students and teachers in the same classroom (and between one classroom and another) have different understandings of the classroom environment which can be traced to sociocultural factors.

Wallace, John **Session 17.11** **Monday, March 24, 1997**
10:30am-12:00pm
Regency E

In Search of Quality in Interpretive Research: Some Stories Read and Some Judgements Made

For many years, the techniques of qualitative research have been constrained by the traditions and frameworks of the quantitative paradigm. Progress has also been impeded by the tendency to look for answers from within the enterprise of research itself. This paper examines some possibilities for alternative genres of interpretive research by drawing on examples from other fields of writing. By analysing several texts from fields such as journalism, history and fictional writing, the study makes some observations about criteria for judging interpretive research.

Walter, Dorothy R. **Session 9.08** **Saturday, March 22, 1997**
2:45pm-3:45pm
Oak Brook IV

Chairpersons Perceptions on Intensive Scheduling in Six High Schools: Implications for Science Education Reform

Thomas M. Dana

The purpose of this study was to examine the perceptions held by high school science department chairpersons as to the intensive/block scheduling process in six rural/suburban high schools. A primary goal was to relate the perceptions held by these science program administrators to reform notions embedded in the National Science Education Standards. This study was a naturalistic study involving transcripts of interviews of six science administrators, notes from limited classrooms observations and a review of school produced literature. Findings were examined in light of the change process and for relevance with respect to the science teaching standards. Results indicate that many of the changes required by the science teaching standards have been accomplished through the necessity of change brought on by Intensive Scheduling. These changes remain unrecognized as linking to the science teaching standards and are viewed as necessary changes in order to deal with the new definition of classroom time within each of the six schools.

Watson, Scott B. **Session 9.01** **Saturday, March 22, 1997**
2:45pm-3:45pm
Hunt 1,2,3

The Effect of the Addition of a Practicum Experience to an Elementary Science Methods Course

Linda James **Susan Mizell**

The purpose of this study was to evaluate the effects of the addition of a practicum experience to an elementary science methods course. Preservice teachers' knowledge of basic and integrated science process skills as well as their attitudes and anxieties towards teaching science were investigated. A further objective of this study was to gather information regarding the participants' feelings about the significance of a practicum experience. Two groups of preservice elementary education majors were included in this study. The first group (n=40) did not have a school-based practicum as part of their methods course. The second group (n=31) had a required practicum as part of the course. Comments from students in both groups indicate that they were pleased with the format of the elementary science methods course in which they participated, but the addition of a practicum would have given (or did give) them a valuable experience in teaching science in a classroom. Although the quantitative data showed no significant differences in either knowledge of process skills or attitude and anxiety between the two groups, the students indicated that it benefited them as a hands-on experience in the classroom and better prepared them for teaching. It was highly recommended by the participants that a field experience be included in the elementary science methods course.

Watters, James J. **Session 3.02** **Friday, March 21, 1997**
7:00pm-8:30pm
Butterfield

Impact of Course and Program Design Features on the Preparation of Preservice Elementary Science Teachers

Ian S. Ginns

Students entering preservice teacher education programs bring with them their own experiences which are likely to be in marked contrast to modern instructional practices espoused by teacher educators and recommended for implementation in schools by science curriculum developers. The purpose of this longitudinal study was to identify instructional strategies in science content and methods courses which may be associated with changes in preservice students' beliefs and attitudes about their ability to teach science. The predominant theoretical influences in the content course were grounded in individual instructors implicit theories in action and the methods course allowed the use of a coherent strategy based on constructivist philosophies. Psychometric tests, interviews, course evaluation questionnaires and field notes were used to detect and monitor changes. Marked fluctuations occurred in scores on instruments designed to measure students' personal beliefs, science related attitudes, and perceptions of their preferred science learning environments, particularly noticeable over a three semester time gap between the content course and the methods course. Implications for teacher education programs are discussed.

Welicker, Miriam **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

How Do Students Perceive a Multi-Dimensional Performance Assessment During Tasks Activity in Biology

Reuven Lazarowitz

The purpose of this study was to evaluate students' perceptions and characterization regarding the multi-dimensional performance and summative assessments. One hundred and thirty six students from four tenth grade classrooms learned the topic of primary prevention of cardiovascular diseases. During their laboratory work, students performed tasks related to the topic and were evaluated by their teachers, with a multi-dimensional performance assessment instrument (MDPAI) on their mastery of inquiry, general cognitive, affective and psychomotor skills. Teachers evaluated students' performance by using a scale from one to eight points. Students were aware to the components of this assessment procedure. At the end of the learning unit, students were also assessed by a multiple choice tests on academic achievement and on mastery of inquiry skills. Following the evaluation procedures, students were handed two questionnaires on perceptions and characterization regarding the two strategies of assessment. One questionnaire used open-ended questions about students' perceptions (preferences, attitudes and feelings) about the performance assessment strategy, and the second one contained characteristic items of the two strategies, which were matched by students to each kind of strategy. Students perceived the performance assessment as relevant, practical, diagnostic, constructive, authentic and honest procedures, which may provide a comprehensive and real picture of students' competence.

Weller, Herman G. **Session 4.03** **Friday, March 21, 1997**
8:30pm-10:00pm
Spring Room

Computer Based Learning in Science: What Have Eight Years of Research Shown? An Analysis of Sixty Research Papers

For over two decades many teachers of science have hoped that computer technology will substantially help them provide students with efficient and effective opportunities to learn both science's *products*--facts principles, laws, and theories--and its *processes*--manipulative and cognitive methods employed in the collection, analysis, synthesis, and evaluation of evidence. A review (Author, in press) of 60 peer-reviewed research articles on computer-based science learning K-16 that have appeared in national journals over the past eight years has shown that technology in science education is still in its emergent phase, and that what we know about its impact from carefully-conducted research studies is still of an almost preliminary nature. The review (Author, in press) included a very brief analysis of the 8-year trends in computer-based science learning. The present paper is a much more detailed analysis of the 8-year trends in computer-based science learning, as shown by the 60 research articles. The present paper is a much more detailed analysis of the 8-year trends in computer-based science learning, as shown by the 60 research articles. Important lessons learned from the research articles are discussed for their relevance to both researchers and teachers of science who are interested in science learning via computer technology.

Welzel, Manuela **Session 8.08** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency B

The Emergence of Understandings of Electricity: Increasing Complexity of Discursive and Material Actions

Stefan von Aufschnaiter

The investigations reported here were designed to describe learning processes in detail and construct theoretical principles of individual learning processes at different age levels. Our work is grounded in a perspective of knowing and learning known as situated cognition; according to this perspective, knowledge is ultimately grounded in each individual's interactions with the material and social world. On the basis of studies at several age levels, we developed a detailed framework that includes operationalizations for levels of situated learning. This framework allows us to quantify certain aspects of learning as they arise from students' interactions with curricular materials and other students. The model consists of the following stages and substages: (a) objects (focusing on aspects, operating on objects); (b) properties (events [recognizing relations between properties], programs [connecting properties]); (c) principles (relationships between principles, networking principles); and (d) systems. Examples from the learning of electricity at four different age levels (Grade 5 to university) are provided to illustrate the development of the cognitive system in the domain of electricity. Based on our framework, we can design and enact curriculum at the appropriate level of complexity for each age group.

Westbrook, Susan L. **Session 14.08** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency C

Whose Class Is This?: Reflections of a Teaching Researcher

Glenda Carter

This study describes how the beliefs and practices of a teaching researcher are mediated by teaching in a public school environment. This study was conducted within the context of two ninth grade physical science classes in a small rural school in the Southeastern United States. One of the researchers assumed the role of teacher for twelve weeks during the school year. The study was embedded within a larger project consisting of a series of teaching experiments implemented to examine classroom discourse. The subsequent experiences of the teaching researcher are viewed through a Vygotskian lens, and the analysis interpreted from the perspective that the classroom teacher and students are the psychological tools that mediate learning for the researcher. Discrepancies in the actual classroom culture and the preferred classroom culture established a disequilibrating situation for the researcher. The findings of this study have implications for understanding how preservice and novice teachers are influenced by the classroom culture.

Westerlund, Julie F. **Session 9.10** **Saturday, March 22, 1997**
2:45pm-3:45pm
Regency B

Reform and Reality: Observations of Texas Teachers on a Biology End-of-Course-Examination

The purpose of this study was to explore the perspectives of biology teachers towards the new Texas state-mandated End of Course Examination in Biology. A heuristic inquiry of four biology teachers and a biology teacher-researcher was conducted over five school semesters. Data were collected by means of interviews, discussions, open-ended questionnaires, self-taped personal journals and observations. Analysis of transcripts included development of codes and theme matrices. The analysis of the data was conducted by two independent analysts. There was agreement between the analyses that the major themes which emerged from the study were: 1) validity, 2) effect on curriculum, 3) student abilities, 4) effect on teachers and 5) accountability of teachers. It appears from this initial study on teacher perspectives concerning the Texas End of Course Exam in Biology that the test does affect teachers and causes them to alter their curricula to prepare their students for the exam. Perspectives of those interviewed raised serious questions about the usefulness of end-of-course exams in multiple-choice formats as a means of reforming science education.

Whigham, Myrna **Session 13.04** **Sunday, March 23, 1997**
2:30pm-3:30pm
Hunt 1,2,3

Gender and Parental and Elementary Pupils Attitudes about Science and Mathematics

In this study, we compared the attitudes of upper elementary school pupils and their parents towards science and mathematics. Attitudes influence student motivation, course, and career selection and improving student attitudes toward science is a national educational goal. Pupils in grades 4-6 and their parents completed surveys. Major results included: boys perceived themselves as more competent than girls in physical science, but not in mathematics, or life science. Girls liked reading more and physical science less than did boys. Children saw physical science occupations as more male dominated. Parents and children perceived the child's abilities similarly. Parents rated subject matter importance the same regardless of sex of child, but male children rated subject matter importance much less than did female students. Additional results and the implications of these findings for educational practice were discussed.

White, Barbara Y. **Session 6.13** **Saturday, March 22, 1997**
10:30am-12:00pm
York 1,2,3

Computer Microworlds and Scientific Inquiry: Enabling Students to Construct Conceptual Models

Christina V. Schwarz **John R. Frederiksen**

Technology is revolutionizing the practices of science and engineering. Once a novelty, computational models of physical systems are now commonplace. They enable scientists to create simulations that embody new types of theories of how the world works. In this talk, we will argue for the importance and feasibility of undertaking a corresponding revolution in science education: one which introduces new goals for science education as well as new methods for achieving those goals. For example, we need to develop new conceptions about expertise in understanding and doing science. We also need new instructional approaches and conceptual tools that enable students to acquire this expertise. Towards this reform agenda, a primary goal of science education should be to help students learn about the nature of scientific models, about the process of constructing models, and about the utility of models in predicting and explaining real-world phenomena. Further, we will illustrate how models that enable both computers and humans to simulate the behavior of a physical system have a key role to play in the development of such expertise. We will conclude with an overview of the ThinkerTools Inquiry Curriculum in which students construct and critique models of force and motion phenomena.

Whitworth, Joan M. **Session 6.11** **Saturday, March 22, 1997**
10:30am-12:00pm
Ogden

Teachers' Personal Learning Theories: Seven Stories of Teachers Engaged in a Science Reform Project

The purpose of this nine month case study of a middle school implementing a major science education reform--based on National Science Teachers Association's (NSTA) Scope, Sequence and Coordination (SS&C)--is to obtain a comprehensive view of a successful reform endeavor from the perspective of the participants. Information concerning the nature of the reform; the influences, results and dilemmas experienced by the participants; a comparison of perspectives between and among participants; and the role of systems thinking in understanding the reforms was obtained through interviews; reform documents; and observations of classrooms, meetings, and planning sessions. Data indicate that the expression of the reform at the classroom level is teacher-dependent. Teacher beliefs at this site acted as both a facilitator and an impediment to implementing and sustaining the science reform. This report describes various teachers, their retained and/or changed beliefs, and the effect of these beliefs on classroom practice within the context of implementing a reform that calls for major changes in the roles of both teachers and students.

Wieseman, Katherine C. **Session 14.11** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency F

An Autobiographical Retrospective: Inquiry Into Beliefs Regarding Middle School Science

For my first doctoral level project I chose to return to my past -- an autobiographical retrospective about a middle school science teacher -- to discover different insights about my teacher beliefs. Beliefs are commonly viewed as key to understanding teacher behavior, underpin practice and reflective teaching. Gilbert (1994) relates that reflective teaching "has been used less commonly by teacher educators as a strategy for the critical evaluation of their own practices" (p. 515). The purpose of this study is to stimulate discourse about reflective teaching in teacher educators, by offering an autobiographical story of beliefs about middle school science and middle grades schooling. Using personal experience methods, conversations (in written form), autobiographical writing, and letters from my last six years as a middle school teacher and first year of graduate study were analyzed. Three domains of teacher beliefs (i.e., the nature of science, the nature of school science teaching, and the nature of learning for middle grades level students) were explicated and a web of associations relating teacher and seventh grade students' perceptions of the joint grade 7 school science course experiences was inferred. Degrees of overlap in perceptions were classified as major, fuzzy, and minor.

Wildy, Helen **Session 13.06** **Sunday, March 23, 1997**
2:30pm-3:30pm
Oak Brook II

The Three C's: Concept, Content, and Context in the Teaching of Physics

John Wallace

This interpretive study examines the implementation of a high school physics curriculum which was designed to teach physics concepts through contexts. The study looks at the teaching and learning of physics, in particular the relationship between concept, content and context. Three issues are explored in the paper. The first issue relates to the difficulties encountered by teachers in shifting from a "content first" to a "context first" approach to teaching physics. The second issue concerns students capacity to learn physics using a context approach. The final issue concerns the nature of physics itself and raises questions about whether the subject can be adequately represented and presented using the context as a vehicle. Several implications for physics curriculum design and delivery are discussed in the paper.

Williamson, Vicki M. **Session 16.02** **Monday, March 24, 1997**
8:30am-10:00am
Kent 1,2,3

The Effect of a Research/Education Experience on Elementary Teachers' Attitudes Toward Science and Process Skills

The purpose of this project was to decrease science phobia and increase attitudes and understandings concerning the process nature of science. This project used a half-day research component in which preservice and inservice elementary teachers experienced scientific inquiry and a half-day education component to facilitate the application of inquiry in the classroom. During the four week summer project, each participant was paired with an undergraduate or graduate science student to work with a research project by developing hypotheses, devising experiments, gathering and analyzing data, and drawing conclusions. In the education component, participants experienced elementary lessons that depicted science as a process, not just a body of facts. The learning cycle approach was used, which emphasizes activity-first, problem solving situations. Learning cycle lessons were developed by the participants to incorporate inquiry and age-appropriate concepts. The improved lessons which resulted from peer teaching were presented to elementary students. The effects on the teacher's attitudes and understandings of process science were evaluated. Significant increases in attitudes were found, along with some gains in process skills. Reflections from participating professors and graduate students, along with those from the participants support the quantitative findings. The project has been repeated for two years, with similar findings.

Wilson, Janice M.

Session 8.07

Saturday, March 22, 1997
1:00pm-2:30pm
Regency A

Structural Variation in Concept Maps about Acid-Base Equilibrium: A Comparative Study of Experts and Novices

This study investigates variation in the structural characteristics of expert and novice participants' concept maps on the topic of acid-base equilibrium. The hypothesis examined was that there would be no significant structural differences between the maps drawn by experts in chemistry and those drawn by novices. The structural variation sought related to differences in hierarchical organization, cohesiveness and complexity. Participants were drawn from distinct groups on the continuum between novices and experts in the domain. Sixty upper secondary chemistry students, forty undergraduate chemistry majors and a sample of honours and doctoral candidates and faculty chemists participated in the study. Association matrices of frequencies of propositional links between paired concepts of participant groups were analysed by the scaling algorithm 'Pathfinder.' Results revealed differences in levels of hierarchical organization, and cohesiveness among the Pathfinder networks derived from the concept maps of the participant groups. Implications for chemistry education are discussed.

Wilson, Julie

Session 17.05

Monday, March 24, 1997
10:30am-12:00pm
Kent 1,2,3

Learning to Teach in a Diverse Setting: A Case Study of a Multicultural Science Education Enthusiast

This study explores the student teaching experience of a multicultural science education enthusiast. In-depth interviews, a journal, and classroom observations were used to capture the student teaching experience. Theme analysis revealed that the student teacher: 1) felt she did not know the students as a group or as individuals; 2) was surrounded by negative beliefs about the students, 3) experienced outside mandates that interfered with her instruction, and 4) attempted to connect instruction and her cultural consciousness. The findings describe obstacles that were salient to a multicultural science education enthusiast while learning to teach in a diverse setting. Some of the obstacles encountered were overcome, and others remained present throughout the student teaching experience. Fellow student teachers and her supervisor were essential to navigating the obstacles she encountered during her student teaching experience.

Winship, Cheryl

Session 7.05

Saturday, March 22, 1997
12:00pm-1:00pm
Oak Brook IV

Effect of Participation in Three Hands-on Museum Programs on Student Knowledge and Attitudes

This paper presents a pragmatic, conceptual framework used in the assessment of students involved in the **Pond Life, Geology and Paleontology Programs** at a suburban museum. The specific purposes of this evaluation were to provide data from students about their reactions to the program in order to determine if the cognitive and affective objectives were achieved, and to identify those features of the programs that might need improvement. A systematic evaluation approach was adopted. The needs of the program participants were assessed prior to the operation of the program. The results of the needs assessment provided the basis for program implementation. To fully assess the success of the program in achieving the stated goals and objectives, a pre-and-post assessment of students' academic skills and confidence in their academic ability in the selected program areas was used. Results indicated that exposure to activities at the museum did indeed enhance school learning, increased knowledge and resulted in positive attitude to science and the desire by many students to become involved in careers in science.

Woodrow, Janice **Session 3.06** **Friday, March 21, 1997**
7:00pm-8:30pm
Kent 1,2,3

Technology Enhanced Instruction: A Successful Model for Science Education

Jolie Mayer-Smith Erminia Pedretti

The purpose of this paper is to present the results and findings of a four year, teacher-researcher collaborative study, called the Technology Enhanced Secondary Science Instruction Project (TESSI). The TESSI project sought to develop a Technology Enhanced Instruction (TEI) model for the integration of technology into science education. The long time frame of the study coupled with the consistent use of the technology by both students and teachers were deemed essential for the TESSI model's assessment and validation. The four year period, in particular, provided the opportunity for both teachers and the researcher to reflect upon the implementation process, test a variety of strategies, and "fine-tune" the teaching-learning process. The resulting model integrates various teaching strategies and learning activities into a cohesive, comprehensive program that demonstrably enhances student learning. The paper examines the essential features of the TESSI model as implemented in two Physics 11 and 12 classrooms, summarizes TEI teaching strategies found to be effective, and details the learning outcomes achieved by the participating students. The results of this study indicate that the TESSI model is particularly successful in increasing enrollment in Physics 12, attracting women students to physics, and helping the "average" student to achieve success in physics.

Wright, Emmett **Session 3.05** **Friday, March 21, 1997**
7:00pm-8:30pm
Hunt 1,2,3

Expertise in Preservice Science Education: An Innovative Approach to Training Elementary Science Educators

Gail Shroyer

According to many of the reports, undergraduate teacher preparation programs are the key to reform in science, mathematics, and technology education at both the elementary school and the secondary school levels. During the fall semester of 1990 Kansas State University initiated the development of a major university-wide model, supported in part by a grant from the National Science Foundation, to reform elementary school mathematics, science, and technology preparation based on the above recommendations. A major focus of the project is the creation of a partnership between the College of Arts and Sciences, the College of Education, and the Manhattan-Ogden Pubic Schools, according to guidelines established by the Holmes Group (1986, 1989, and 1990), the Carnegie Forum (1986), and Goodlad (1990). Three professional development schools were created in the public school system as an outcome of this collaborative effort. The professional development schools and the partnership between the university and the public schools serves as a model of the Kansas State University teacher preparation program. Teachers have gone through the program and graduated. Preliminary data indicate that these teachers are superior to other graduates especially in science and mathematics.

Wubbels, Theo **Session 8.10** **Saturday, March 22, 1997**
1:00pm-2:30pm
Regency D

The Teacher's Contribution to the Social Climate of the Classroom

This paper reports research on teachers' contributions to a positive social climate in science classes, particularly through their interaction or communication with students. The way in which a teacher interacts with students is not only a predictor of student achievement, but also it is related to such factors as teacher job satisfaction and teacher burnout. Overall, the research reinforces the importance of teacher behavior for creating a classroom atmosphere conducive for science learning. Affective variables seem to be important in a traditional classroom and even more important in a 'constructivist' classroom, where emotion plays a more prominent role. The research reported suggests that, in their communication with students, science teachers should strive to establish relationships characterised by high degrees of leadership, helpful/friendly and understanding behavior. In order to succeed, teachers' non-verbal behavior in whole-class teaching should guarantee good visual contact (e.g., by scanning the class) and teachers should 'hold the floor' verbally. When applying open teaching styles, teachers should avoid the risk of disorderly climates.

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Yarrow, Alan

Session 9.07

Saturday, March 22, 1997
2:45pm-3:45pm
Oak Brook IV

Applying Learning Environment Ideas in Teacher Education: Improving University and School Classrooms

Jan Milwater **Barry J. Fraser**

Although the field of classroom learning environment provides potentially valuable ideas to help science teachers become more reflective and improve practice, these ideas have had limited infiltration into teacher education. In this study, preservice teachers were introduced to the field of learning environments by being involved in action research aimed at improving the environment of (1) their university teacher education classes and (2) their elementary school classroom environments during teaching practice. The basic approach involved using assessments of student perceptions of actual and preferred classroom environment to identify actual-preferred discrepancies and guide improvements. A sample of 100 preservice elementary teachers were involved in attempts to improve the environments of their university classes and of their 100 elementary classes during their teaching practice. This paper reports several specific case studies of environmental change attempts and provides evidence about the efficacy of the strategy of using classroom environment assessments in improving classrooms. Generally, preservice teachers valued inclusion of the topic of learning environments in their preservice program and the opportunity to be involved in action research aimed at improving classroom environments.

Yore, Larry D.

Session 17.08

Monday, March 24, 1997
10:30am-12:00pm
Regency B

Reforms. Visions and Standards: A Cross-Curricular View from an Elementary School Perspective

Carole Ford **Robert J. Anthony**

During the 1990s discipline-specific associations have attempted to reform education with a variety of visions and standards. Most of these efforts have been independent of one another with minimal cross-curricular input on one another's steering committees and working groups. In some cases, there appears to be explicit collaboration between related associations while others do not appear to have been strategically collaborative. This paper examines the resulting reform documents (Benchmarks for Science Literacy, AAAS, 1993; Curriculum Standards for Social Studies: Expectations of Excellence, NCSS, 1994; Curriculum and Evaluation Standards for School Mathematics, NCTM, 1989; Professional Standards for Teaching Mathematics, NCTM, 1991; Standards for the English Language Arts, IRA/NCTE, 1996; National Science Education Standards, NRC, 1996; Technology for All Americans, IATE; in press) from a cross-curricular elementary school perspective. This analysis revealed that the collective vision contained common assertions: 1.Literacy, a common focus of all reforms, involves the knowledge, habits of mind and strategies to construct informed opinions and big ideas and the communicative abilities to inform and persuade others about these ideas. 2. Critical thinking is an embedded, implicit epistemology of literacy. 3. Teaching and learning involves a sociocultural phenomena with a private sense-making process.

Yorker, Christine

Session 10.11

Saturday, March 22, 1997
4:00pm-5:30pm
Regency D

Kids as Global Scientists: The Teacher's Role in Educational Reform

In this research I examine key assumptions inherent in contemporary learning theory: the role of prior knowledge in learning, the importance of social interaction in learning, the situated nature of knowledge and the concept of knowledge as distributed by examining teachers' participation on a listserve to support an Internet-based curriculum. Addressing these classroom implications requires consideration of the role of the teacher in creating productive classroom learning experiences for students. During the first three years of the KGS project, no forum for teacher interaction was provided. Teacher feedback during the third year suggested that KGS teachers might benefit from interaction with one another. We began to develop the idea of building a 'community of learners' among KGS teachers with an electronic listserve, drawing on literature focused on communities of learners as well as the teacher learning literature and the limited literature on listserve communities of learners. The listserve endeavor was a gratifying success in terms of impact on teachers who actively participated. Volunteers wrote rich and complex descriptions of KGS experiences that triggered thoughtful, analytical and supportive discussion on the listserve. Yet, while all teachers logged on and many teachers were active, roughly 70% of the teachers did not engage in listserve discussion beyond the point of introducing themselves, including those who had made an explicit commitment to do so.

Zain, Ahmad Nurulazam **Session 14.11** **Sunday, March 23, 1997**
4:00pm-5:00pm
Regency F

Elementary Science Teachers' Beliefs Regarding Instruction in Science

Ismail Jusoh **Zurida Ismail**

This study was conducted with a group of 350 elementary science teachers designed to investigate on one possible contributor to behavior patterns of elementary teachers i.e., their beliefs regarding instruction in science. They were required to respond to the Science Teaching Efficacy Belief Instrument (STEBI) (Riggs & Enochs, 1990) which was used to assess the levels of confidence in their ability to teach science and willingness to assume responsibility. The results of the study indicated that these group of elementary teachers have a high sense of teaching efficacy and personal sense of teaching efficacy. They are generally confident in their teaching competencies and command of the content-pedagogical knowledge. Respondents were generally willing to assume that student learning in the content areas of science is the responsibility of the teacher.

Zeidler, Dana **Session 8.02** **Saturday, March 22, 1997**
1:00pm-2:30pm
Hunt 1,2,3

Meeting the Challenge of Professional Development: Design and Evaluation of a Telecommunications Mediated STS Course

John F. LeBaron

The purpose of this investigation was to describe, document and evaluate the implementation of a technology-driven graduate course which could serve as a model for other public institutions. The course focused specifically on examining how the work of private and public Research and Development organizations dovetails with contemporary science education goals. Propositional statements related to "habits of mind" in science and mathematics education served to extend classroom experiences into on-line group discussions involving students, researchers from public and private organizations, and faculty. Project evaluation utilized both informal and formal assessments. The procedure selected for the formal assessment was an Evaluability Assessment Model which served to describe and clarify the on-going development of the program's theory, determining and assessing the underlying logic and functional aspects of the program model, and identifying stakeholder's perceptions and concerns. A synthesis of these evaluations is provided which details beneficial pedagogical outcomes that serve to enhance the professional development of science and mathematics teachers.

Zembal-Saul, Carla M. **Session 9.02** **Saturday, March 22, 1997**
2:45pm-3:45pm
Kent 1,2,3

The Role of Cycles of Instruction in Preservice Elementary Teachers' Science Content Representations

designed two-year elementary preparation program. Prior research defines content representation in terms of accuracy and attention to learners' prior knowledge. This study addresses it more broadly by considering issues of linking concepts, engaging learners cognitively, and managing organization structures to facilitate content representation. In contrast to previous investigations, this study drew on multiple data sources from different phases of instruction, is longitudinal, and focuses on elementary education students. During the first year, preservice teachers engaged in two cycles of instruction guided by questions about content, learners, and management. For each term, written, audiotaped, and videotaped information about planning, teaching, and reflection were analyzed. Findings suggest that preservice teachers were able to develop multiple and accurate representations that related to children's everyday experiences. Over time, they also planned more connections among ideas, techniques to promote thinking, and strategies for managing participation, resources, and time. During interactive teaching, they continued to experience difficulty responding to students' questions and maintaining lesson pacing. They also became better able to reflect on the strengths and weaknesses of their representations, provide explanations for problems, and propose reasonable modifications and alternatives.

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Zohar, Anat **Session 14.12** **Sunday, March 23, 1997**
4:00pm-5:00pm
York 1,2,3

Assessing the Cognitive Level of Teachers' Questioning in Class Discourse Homework Assignment and Tests

Pinchas Tamir **Noa Schwarzer**

An important question which is often overlooked addresses the nature and quantity of higher order thinking activities apart from the "thinking curriculum", i.e. circumstances under which teachers do not think explicitly of "teaching for thinking" as a distinct purpose, but rather act and behave routinely. The study investigates the scope and nature of tasks demanding students' application of higher order thinking skills while studying biology in junior and senior high schools in Israel. The method used is collection and analysis of questions asked by teachers during classroom discourse, in homework assignments and in tests. The main findings show: (a) that the frequency of higher order thinking questions in biology class discourse in Israel is approximately 20%; (b) that the cognitive level of teachers' questioning in HS is higher than in JHS; ~ that the matriculation exam has a strong influence on tests given by teachers and, (d) that while inquiry questions permeated HS testing they are less salient in HS class discourse, indicating that enhancing the amount of inquiry activities in biology lessons may improve students' scores in the matriculation inquiry questions.

Zoller, Uri **Session 12.12** **Sunday, March 23, 1997**
10:30am-12:00pm
York 1,2,3

College Students' Self Assessment in HOCS and LOCS Chemistry Examinations

Georgios Tasparlis **Michal Fastow** **Aviva Lubezky**

The purpose of this study was two fold: (a) to involve college science students in the evaluation process via their self-assessment of their HOCS (mainly) and LOCS performance in chemistry examinations; and (b) to find out whether the students assessment is compatible with that of their professors and to what extent are the students confident in doing this. Both, Freshman students (N = 134, 52 in Israel and 82 in Greece) and their professors assessed/graded, specially designed, five item HOCS oriented chemistry exam. The exam was administered as a take-home exam followed by students' appraisal of their confident in self- and peers assessment via an attached Likert-type questionnaire. The main results were: (a) students' self-assessment of LOCS questions matched with that of their professors, but was incompatible with respect to HOCS questions; (b) Students overestimated grades, compared with their professors, in their self-evaluation, particularly with respect to HOCS questions; (c) students believed that they are reasonably capable of self-assessment and were quite confident in doing that. Since student self-assessment is consonant with the HOCS orientation in current science education reform, it should be implemented and fostered in order to become a routine practice within science teaching.

Zuzovsky, Ruth **Session 10.03** **Saturday, March 22, 1997**
4:00pm-5:30pm
Kent 1,2,3

Modeling School Effectiveness in Science Teaching: Validating a School Effectiveness Model and Constructing an Indicator System

Murray Aitkin

This paper describes the coupled process of specifying and validating a model of school effectiveness in science teaching and developing an indicator system for monitoring science teaching based on such a model. An initial model in line with the organizational framework of school effectiveness (Bar & Dreeben, 1983; Bidwell, 1983) which emphasized the hierarchical nature of the educational system, guided the specification of variables or indicators known as having an effect on science teaching outcomes. The hierarchical structure of such a model required the use of multilevel analysis methods (Goldstein, 1995; Longford, 1993; Raudenbush & Bryk, 1992). The ability to allow the effects of certain low level variables in a hierarchy (i.e., pupil characteristics) to vary randomly over higher level units (schools or classes) - allowed the model to reveal random effects that can be explained as interaction effects. Findings supported the claim that the modeling of school effectiveness studies must be both multilevel and interactive. Achievements were found to be dependent in a very sensitive, non-additive way, on the particular combination of pupil's home background, his or her general ability, teaching style and other characteristics of teacher, class and school context in which the pupil learns. Although the explanatory power of the interaction model was slightly smaller, the information it yielded was much more detailed and accurate. A repeated study after eight years enabled us to delineate and compare two final interactive models of science teaching, and to validate the model of school effectiveness in this subject area according to the stability of its educational interpretation and the stability, if not improvement, of its explanatory power.

Zuzovsky, Ruth **Session 6.04** **Saturday, March 22, 1997**
10:30am-12:00pm
Cermak

Assessing Scientific Literacy: An Alternative Assessment Study of the Elementary STS Curriculum in Israel

This paper presents findings from a large scale summative evaluation study that aimed to evaluate the outcomes for scientific literacy of the elementary science curriculum in Israel. Four alternative assessment tasks were constructed and used to supplement the TIMSS study. Participants in the study were 2,800 6th grade students randomly selected from 100 schools. It was found that attainment level of three aspects of scientific literacy -- cultural, functional, and true scientific literacy -- were very low. One-third of students avoided answering the open-ended questions. Students scored highest on the understanding and making use of scientific and technological information. It was found that boys and girls had similar attainment levels, and that for conceptual knowledge, students scored much higher on multiple choice tests than on the alternative assessment tasks.

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Kress, Gunther 13.09
Krockover, Gerald H. 8.02
Kroß, Angela 3.07
Kuider, Wilmad 10.13
Kull, Judy R. 13.05
Kurth, Lori A. 3.04 12.02 13.06
Kwon, Yong-Ju 8.12
Kyle, William C., Jr. 14.05 17.02
Lachance-Whitcomb, J. 16.06
Ladewski, Barbara G. 16.03
Lane, Paula 12.02
Larson, Jane O. 10.10
Lavoie, Derrick R. 7.08
Lawrence, Chris 6.07
Lawrenz, Frances 14.02
Lawson, Anton E. 8.12
Lazarowitz, Reuven 13.03 13.04 17.05
Leander, Kevin 16.03
Leary, Rosemary F. 13.02
LeBaron, John F. 8.02
Lederman, Norman G. 6.02 16.03 17.03
Lee, Ohkee 8.06 12.11
Lee, Pei-ling 7.03

Lee, Soo-Young 8.07
Lee, Teresa Ping 13.04
Lefurgy, Scott T. 9.03
Lehman, James D. 3.06 7.03
Lennon, Diane 17.10
Lento, Eileen 16.06
Letts, William J., IV 12.12 17.03
Lewis, Bradford F. 10.06
Lewis, Clayton 8.11
Lewis, JoAnne O. 6.05
Liang, Ling L. 12.12 16.04
Lin, Xiaodong 6.13
Linn, Marcia C. 6.13 16.06
Liu, Chin-Tang 7.12 14.02
Liu, Xiufeng 6.10
Lomask, Michal 7.12
Louden, Cynthia K. 6.07
Louden, William 10.13
Loudon, G. Marc 12.12
Loving, Cathleen C. 9.04 10.12 17.03
Lowrey, Kirsten 12.12
Lubezky, Aviva 12.12
Lucas, Keith 8.02
Lucy, Edward C. 13.02
Lumpe, Andrew T. 6.06 17.08
Lumsden, Ann 7.10
Lynch, Sharon 8.06
Lyons, David 12.09
MacIsaac, Doug 12.04
Magnusson, Shirley J. 8.07 16.02
Mamlok, Rachel 10.03
Mandell, Susan 3.06
Maor, Dorit 3.06 6.04
Marano, Nancy 16.02
Marbach-Ad, Gili 14.07
Marek, Edmund A. 12.03
Marlow, Michael P. 3.02
Marlow, Stacey E. 16.03
Martin, Elaine 6.03
Martin, Laura 13.02
Martins, Isabel 13.09
Marucci, Giuseppe 17.08
Mason, Diana 3.03
Matkins, Juanita Jo 6.03
Matthews, Michael 10.12
Matthews, Michael R. 7.04
Mayer, Jürgen 14.07
Mayer-Smith, Jolie 3.06 14.09
McArthur, Julia 9.07
McClafferty, Terence P. 14.03
McComas, William F. 10.07 12.08
McConney, Amanda W. 17.06
McElroy, Keith 16.04
McGillicuddy, Kieran 13.09
McGinn, Michelle K. 7.08 8.08
McGinnis, Randy J. 12.07 13.08
McGlamery, Sheryl 12.04
McGrew-Zoubi, Robin 4.01
McMahon, Maureen 10.07 12.08
McNamara, James 8.03
McRobbie, Campbell J. 8.10 9.14
Meadows, Lee 6.12 16.07
Melear, Claudia T. 3.03
Merino, Barbara 3.02
Michael, William B. 14.07
Middlebrooks, Sally 10.07
Miller, Jon D. 17.01
Milwater, Jan 9.07
Minch, Sherrill L. 16.04
Mintzes, Joel 6.07 9.12
Mistler-Jackson, M. 10.11
Mizell, Susan 9.01
Monhardt, Leigh 6.05
Monhardt, Rebecca M. 13.04
Morais, Ana 6.07
Morrell, Patricia 3.09
Moscovici, Hedy 10.02
Moss, David 13.05
Muire, Chris 12.11
Muire, Willis C., Jr. 7.06 16.04 17.09
Naizer, Gilbert L. 14.01
Nakhleh, Mary B. 13.07
Narro, Martha L. 16.01
Nason, Patricia L. 6.10 9.07
Neto, Antonio J. 9.12 10.09
Neto Vaz, Adelaide 9.12
Neves, Isabel P. 6.07
Newhouse-Maiden, L. 16.07
Nichols, Kim 9.02
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Nielsen, Laura Wang 12.03
Nieswandt, Martina 7.11
Norman, John 9.10 12.10
Norman, Katherine 17.05
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Nott, Mick 9.05 16.08
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Oelkers, Jürgen 17.01
Ogborn, Jon 13.09
Ogonowski, Mark 7.01
Okebukola, Peter 10.10
Olabisi, Ajayi 12.10
Oliveira, M. Teresa 17.08
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Oliver, J. Steve 3.11 6.12 12.04
Olkin, Arlene 17.07
Olsen, Timothy P. 9.04
Orpwood, Graham 10.08
Osborne, Margery D. 7.07 16.03 17.13
Osisioma, U. I. N. 8.09
Ostman, Leif 10.08
Padilla, Michael J. 4.01
Paik, Susan 17.01
Palincsar, Annemarie 16.02

Palmer, Troy D. 7.06 10.02
Palmeri, Amy 17.04
Park, John C. 12.10 14.09
Parke, Helen 10.10
Parker, Dawn 8.03
Parker, Joyce 16.09
Parker, Lesley H. 3.03 16.07
Parsons, Sharon 12.04
Pea, Roy D. 5.01 6.01 6.13 16.06 17.06
Peasley, Kathleen 7.08
Pedretti, Erminia 3.06 12.03 14.09
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Petrosino, Anthony J. 6.13
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Powell, Janet Carlson 10.11
Powell, Kathryn 16.01
Prain, V. 7.11
Priebe, Roger 3.04
Priestley, Holly 12.05
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Puttick, Gillian M. 8.05
Pyle, Eric J. 7.10 17.14
Rader, Cyndi 8.11
Raisen, Senta 3.05
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Rebello, Sanjay N. 13.07
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Reiner, Miriam 7.07 8.08
Reiser, Brian J. 17.06
Rennie, Léonie J. 3.03 12.08 14.03 16.07
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Richmond, Gail 8.09 12.02 13.06
Rickards, Tony W. 8.09
Riley, Joseph P., II 4.01 17.08
Roberson, Jeanie 9.01
Roberts, Douglas A. 10.08
Robinson, Cecil D. 8.11
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Rodriguez, Alberto J. 3.03 8.06 12.11
Rogers, Laura N. 6.06
Rogg, Steven R. 9.10 14.06
Roseman, Jo Ellen 14.06
Roth, Kathleen 6.09 12.02 17.02
Roth, Wolff-Michael 6.09 7.08 8.04 8.08
Rowel, Patricia 6.10
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Rush, Michael 3.06
Rye, James A. 6.10
Saama, Gilli 12.07
Salmi, Hannu 14.03
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Scantlebury, Kathryn 6.03 7.02
Scarpone, Christopher 8.12
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Schmidt, William H. 1.01 3.01
Schmuckler, Joseph 12.05
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Schriver, Martha 13.04
Schwarz, Christina V. 6.13
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Sears, John 17.05
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Sessoms, Deidre B. 3.03 6.03
Settlage, John 9.09 10.07 15.01 16.01
Shaffer, Martin 13.05
Shapiro, Bonnie 8.10
Shaw, Edward L. 13.04
Shayer, Michael 16.05
She, Hsiao-Ching 3.10 8.09
Shell, Duane F. 13.01
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Shroyer, Gail 3.05
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Siner, Suzanne A. 10.04
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Slaughter, Jeanne 16.01
Slavings, Rosalind 13.04
Slough, Scott 4.01
Smith, Coralee 9.09
Smith, Darwin W. 9.06
Smith, Edward L. 3.04
Smith, Philip J. 10.10 14.09
Smithey, Margaret W. 9.01
Snipes, Christy 14.01
Soloway, Elliot 6.13 12.09
Songer, Nancy Butler 10.11
Southerland, Sherry A. 9.11 14.07 17.05
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Stahl, Robert J. 13.06 13.09
Stana, Pamela T. 9.01
Starr, Mary L. 9.02
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Stavy, Ruth 14.07
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Sterling, Donna 17.07
Stohr-Hunt, Patricia M. 7.12
Stolte, Sabine 3.07
Stratford, Steven J. 6.13 14.09
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Stubbs, Harriett 3.09
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Suter, Larry E. 8.01
Sutman, Frank X. 12.11
Svec, Michael 16.01
Swami, Piyush 7.10
Talsma, Valerie L. 14.01
Tamir, Pinchas 14.12
Tao, Ping-Kee 10.09
Tasparlis, Georgios 12.12
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Taylor, Wendy 13.05
Thau, Allison 7.05
Thomas, Julie A. 6.06 8.03
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Tobin, Kenneth 8.05 9.05 9.14 12.11 13.08 17.11
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Treagust, David F. 3.08 3.10 9.11 12.04 13.05
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Van Sickle, Meta 17.05
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Varelas, Maria 6.09
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Varrella, Gary F. 3.05 8.13 9.10
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Vopava, Judy 3.05
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Walberg, Herbert J. 8.10
Waldrip, Bruce G. 12.08 12.11
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Watson, Scott B. 9.01
Watters, James J. 3.02
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Welicker, Miriam 13.04
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Welzel, Manuela 8.08
Westbrook, Susan L. 8.04 14.08
Westerlund, Julie F. 9.10
Whigham, Myrna 6.08 13.04
White, Barbara Y. 6.13
White, Richard 6.13
Whitworth, Joan M. 6.11
Wick, Don 6.05
Wieseman, Katherine C. 9.06 14.11
Wilbers, Jens 8.08
Wilcox, Jacki 17.04
Wildy, Helen 13.06
Williamson, Vicki M. 16.02
Wilson, Janice M. 8.07
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Wiltz, Nancy W. 10.07
Winship, Cheryl 7.05
Wisnudel-Spitulnik, M. 6.13
Wolner, Karen 17.10
Woodrow, Janice 3.06 14.09
Wright, Emmett L. 3.05 12.04
Wubbels, Theo 8.10
Yager, Robert E. 3.05 8.13
Yang, Jong-Hsiang 3.10
Yarrow, Alan 9.07
Yeany, Russell H. 3.11
Yeotis, Cathy 12.10
Yerrick, Randy 6.09 17.02
Yore, Larry D. 14.02 17.08
Yorker, Christine 10.11
Zaiman, Joseph 9.04
Zain, Ahmad N. 14.11
Zeidler, Dana 8.02
Zembal-Saul, Carla M. 9.02
Zohar, Anat 14.12
Zoller, Uri 12.12
Zollman, Dean A. 13.07
Zuzovsky, Ruth 6.04 10.03